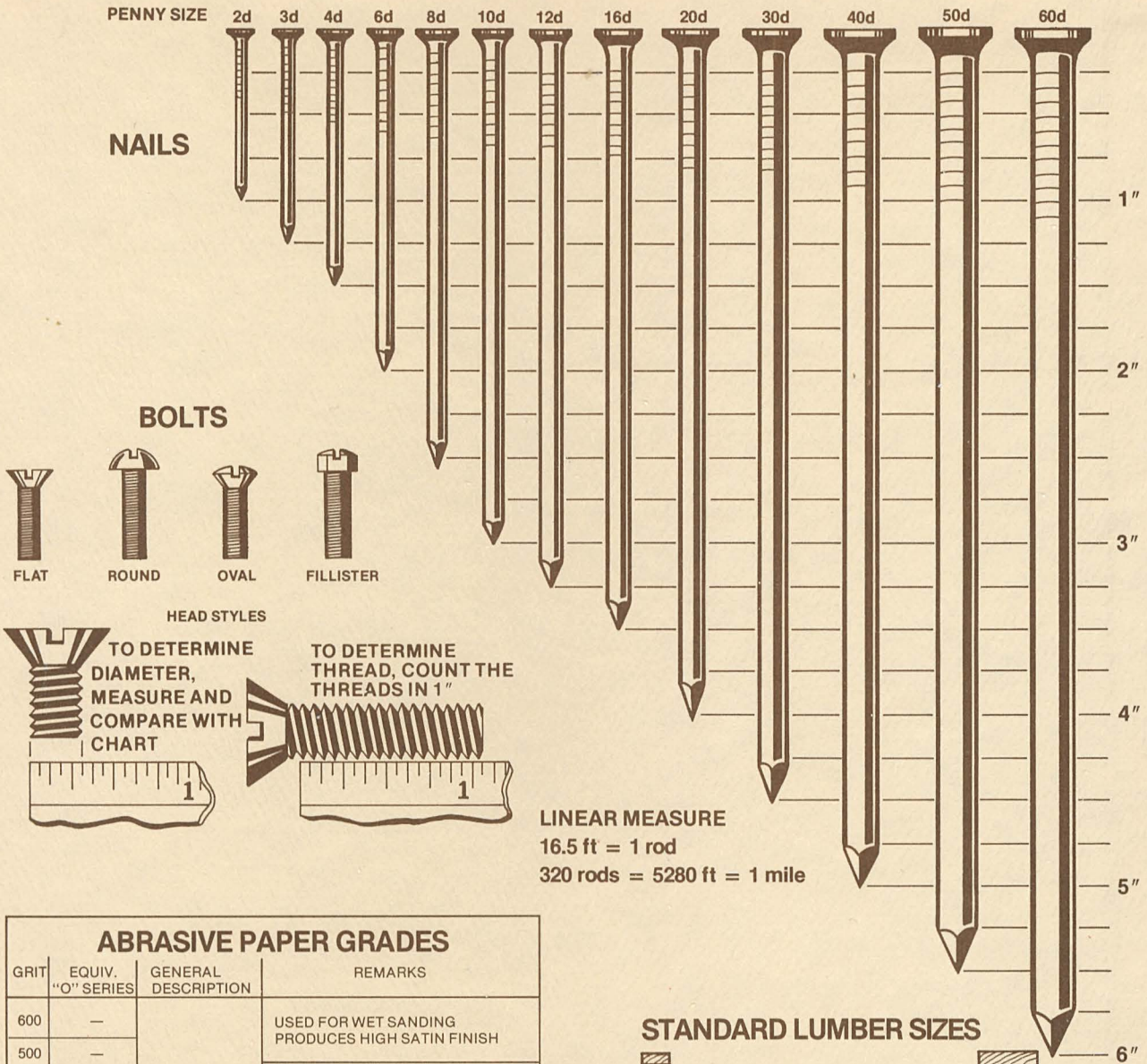
Popular Mechanics

do-it-yourself yearbook 1981

SHOP GUIDE

NAILS



BOLTS

HEAD STYLES

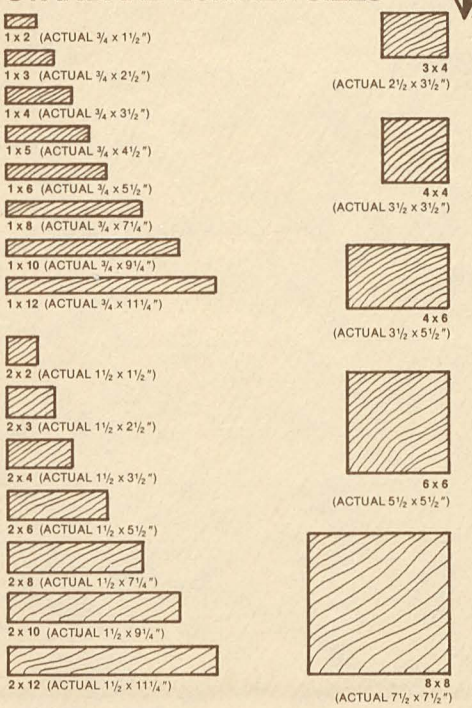
LINEAR MEASURE
16.5 ft = 1 rod
320 rods = 5280 ft = 1 mile

ABRASIVE PAPER GRADES

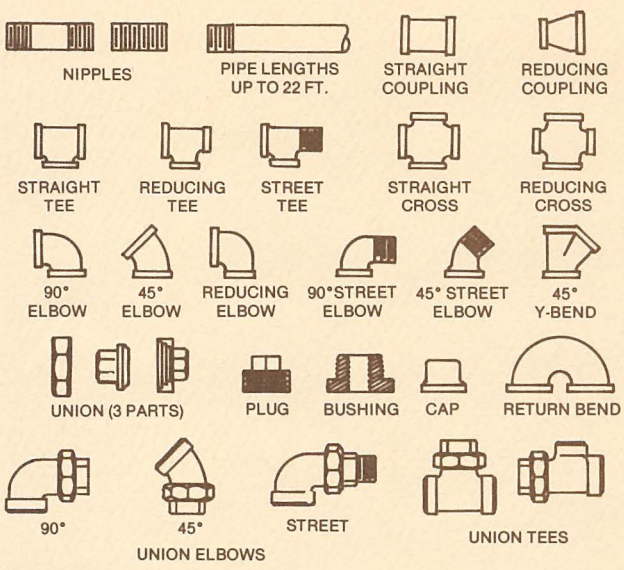
GRIT	EQUIV. "O" SERIES	GENERAL DESCRIPTION	REMARKS
600	—	SUPER-FINE	USED FOR WET SANDING PRODUCES HIGH SATIN FINISH
500	—		
400	10/0		GENERAL RANGE OF ABRASIVE PAPERS USED FOR WET SANDING LACQUER AND VARNISH TOP COATS
360	—		
320	9/0		
280	8/0	VERY FINE	USED FOR DRY SANDING ALL FINISHING UNDERCOATS. THESE GRADES WILL NOT SHOW SANDING MARKS
240	7/0		
220	6/0*		
180	5/0	FINE	FOR FINAL SANDING OF BARE WOOD. GOOD FOR SMOOTHING OLD PAINT
150	4/0*		
120	3/0	MEDIUM	USE FOR GENERAL WOOD SANDING. GOOD FOR FIRST SMOOTHING OF OLD PAINT, PLASTER PATCHES
100	2/0*		
80	1/0		
60	½*	COARSE	USE No. ½ FOR ROUGH-WOOD SANDING. No. 1 IS COARSEST PAPER WHICH CAN BE USED TO ADVANTAGE WITH PAD SANDER
50	1		
40	1½		
36	2	VERY COARSE	ALL TOO COARSE FOR PAD SANDERS. THESE GRADES REQUIRE HEAVY MACHINES AND HIGH SPEED TO CUT WELL
30	2½		
24	3		

Grades generally supplied as Very Fine, Fine, Medium and Coarse

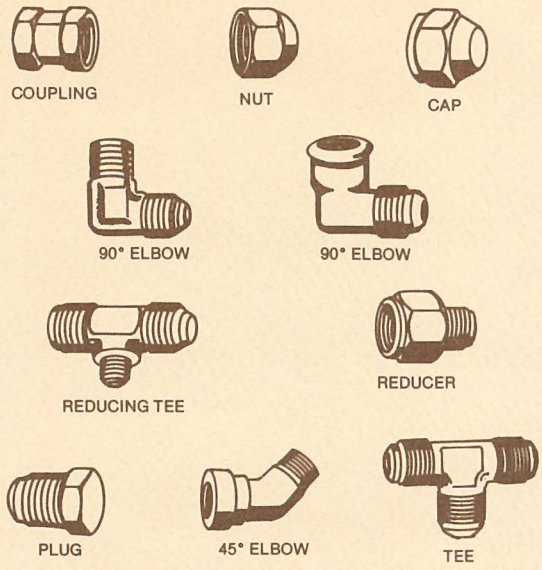
STANDARD LUMBER SIZES


1 x 2 (ACTUAL ¾ x 1½")
1 x 3 (ACTUAL ¾ x 2½")
1 x 4 (ACTUAL ¾ x 3½")
1 x 5 (ACTUAL ¾ x 4½")
1 x 6 (ACTUAL ¾ x 5½")
1 x 8 (ACTUAL ¾ x 7¼")
1 x 10 (ACTUAL ¾ x 9¼")
1 x 12 (ACTUAL ¾ x 11¼")
2 x 2 (ACTUAL 1½ x 1½")
2 x 3 (ACTUAL 1½ x 2½")
2 x 4 (ACTUAL 1½ x 3½")
2 x 6 (ACTUAL 1½ x 5½")
2 x 8 (ACTUAL 1½ x 7¼")
2 x 10 (ACTUAL 1½ x 9¼")
2 x 12 (ACTUAL 1½ x 11¼")
3 x 4 (ACTUAL 2½ x 3½")
4 x 4 (ACTUAL 3½ x 3½")
4 x 6 (ACTUAL 3½ x 5½")
6 x 6 (ACTUAL 5½ x 5½")
8 x 8 (ACTUAL 7½ x 7½")

PIPE FITTINGS



Here are the common steel pipe fittings. Nipples are simply short lengths of pipe threaded on both ends. Reducing fittings join two different sizes of pipe.



Compression fittings of the flared-tube type are the easiest for the novice to handle when working with copper tubing.

STANDARD STEEL PIPE
(All Dimensions in Inches)

Nominal Size	Outside Diameter	Inside Diameter	Nominal Size	Outside Diameter	Inside Diameter
⅛	0.405	0.269	1	1.315	1.049
¼	0.540	0.364	1¼	1.660	1.380
⅜	0.675	0.493	1½	1.900	1.610
½	0.840	0.622	2	2.375	2.067
¾	1.050	0.824	2½	2.875	2.469

SQUARE MEASURE

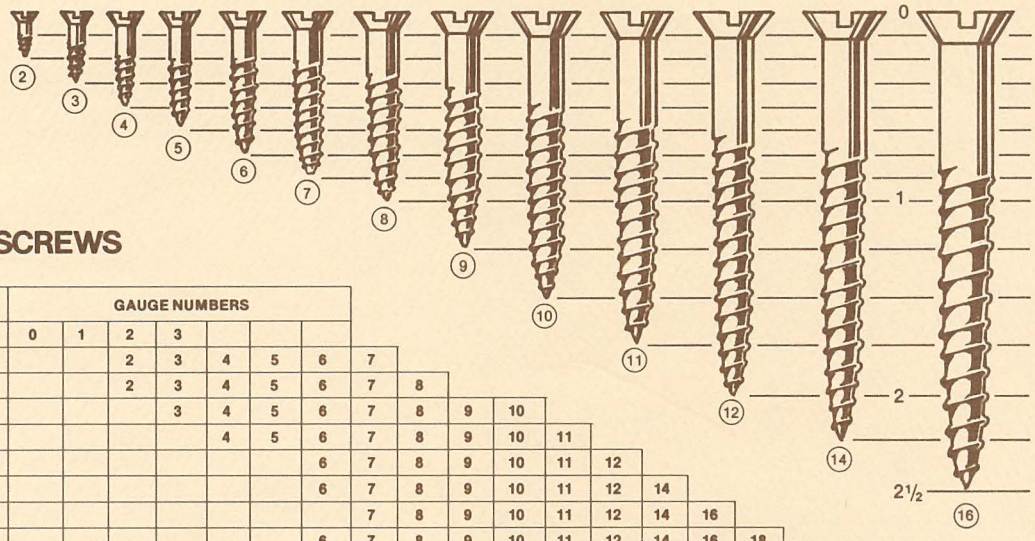
144 sq in = 1 sq ft
9 sq ft = 1 sq yd
272.25 sq ft = 1 sq rod
160 sq rods = 1 acre

VOLUME MEASURE

1728 cu in = 1 cu ft
27 cu ft = 1 cu yd

MEASURES OF CAPACITY

1 cup = 8 fl oz
2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
2 gallons = 1 peck
4 pecks = 1 bushel



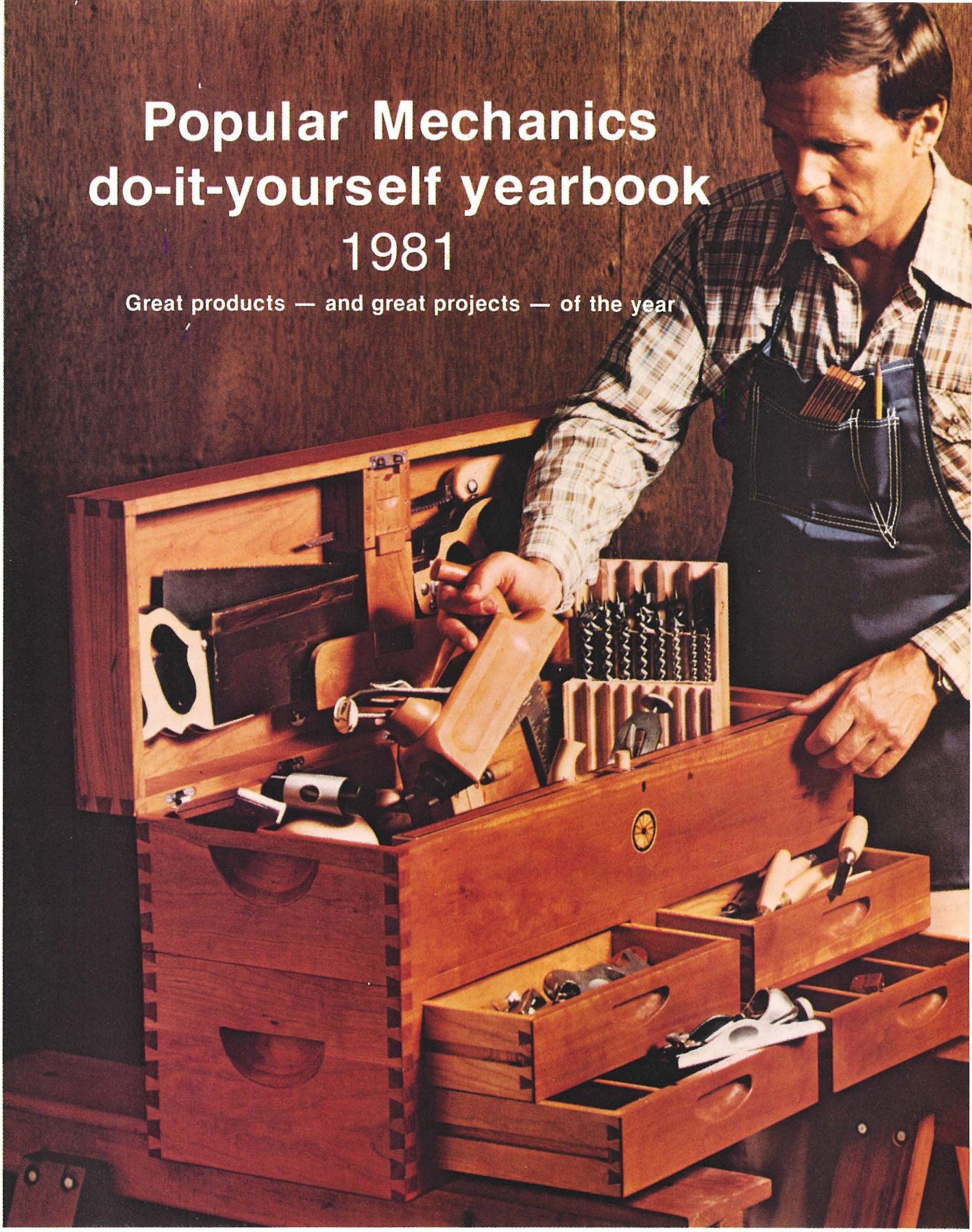
WOOD SCREWS

LENGTH	GAUGE NUMBERS																
¼ INCH	0	1	2	3													
⅜ INCH			2	3	4	5	6	7									
½ INCH			2	3	4	5	6	7	8								
⅝ INCH				3	4	5	6	7	8	9	10						
¾ INCH					4	5	6	7	8	9	10	11					
⅞ INCH							6	7	8	9	10	11	12				
1 INCH							6	7	8	9	10	11	12	14			
1¼ INCH								7	8	9	10	11	12	14	16		
1½ INCH							6	7	8	9	10	11	12	14	16	18	
1¾ INCH									8	9	10	11	12	14	16	18	20
2 INCH									8	9	10	11	12	14	16	18	20
2¼ INCH										9	10	11	12	14	16	18	20
2½ INCH													12	14	16	18	20
2¾ INCH														14	16	18	20
3 INCH															16	18	20
3½ INCH																18	20	24
4 INCH																18	20	24

WHEN YOU BUY SCREWS, SPECIFY (1) LENGTH, (2) GAUGE NUMBER, (3) TYPE OF HEAD—FLAT, ROUND, OR OVAL, (4) MATERIAL—STEEL, BRASS, BRONZE, ETC., (5) FINISH—BRIGHT, STEEL BLUED, CADMIUM, NICKEL, OR CHROMIUM PLATED.

Popular Mechanics do-it-yourself yearbook 1981

Great products — and great projects — of the year



TALK ABOUT A TOOL CHEST! Here's one for a master craftsman, designed by a professional. The chest offers beautifully organized hand-tool storage, wood construction that absorbs moisture and protects tools from rust, and fascinating drawer stops, locks and ornamentation. There's even an oak dolly that makes toting the chest over level surfaces easy. Adapt this work of art to your own needs. Plans start on page 102.

THIS HANDSOME FAMILY ROOM, converted from a garage, is filled with ideas you may want to adapt. There's a daybed that sleeps two, surrounded by a desk and filing cabinets. There are roll-around benches, a roll-about sewing center, and storage galore, including a yarn bin. See the plans on page 52.

CROSS-COUNTRY SKIING is just one of the joys of winter camping. An article on page 148 gives snow-camp tips, and suggests what gear to take.

AFTER THE TENTS and sleeping gear are unloaded, a snowmobile tow sledge makes a fine chuck wagon for hot stove-cooked meals.

TURN THE KIDS LOOSE on this ladder-climber and it's a desk, jail, fort or spaceship. You can build it with hand tools. See page 174.

BUILD THE BEST lemonade stand in town! This one is bound to make any youngster an entrepreneur. It folds neatly in half, tows to the site. See page 176.

BUILD A HOT TUB into your deck and get in on all the fun! You can install one in a small space or on hilly property—places where you can't install a swimming pool. Then enjoy the massage effect of that hot whirlpool. The article on page 4 tells how to assemble the tub and install it in your deck.

MAKE YOUR ENTRY say welcome! We brightened up a long, dark entry hall with all kinds of attractive and adaptable ideas. Then we designed and built a table-bench that offers a place to display flowers, a drawer for scarves and gloves, and a seat for pulling on boots. See details on page 81.

SMALL BOATS are suddenly "in." They offer more fun for less fuel. Hulls are sleeker and lighter, small motors pack more punch. See our roundup on page 28.

YOU'LL FIND great gear for underwater fun on page 22. It includes slick new diving aids, plus details on a scuba-tow you can build.

Popular Mechanics do-it-yourself yearbook 1981

Exciting new products

- for your home
- for your shop
- gear for outdoorsmen
- the best of the new tools
- what's new for photographers
- newsmakers in electronics

Great projects of the year

- to improve your home
- shop know-how
- challenging craft projects
- how-to in the great outdoors
- photo projects
- electronics know-how
- projects just for fun

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Build in a hot tub

Put yourself in hot water! Build this California-style hot tub

By HARRY WICKS

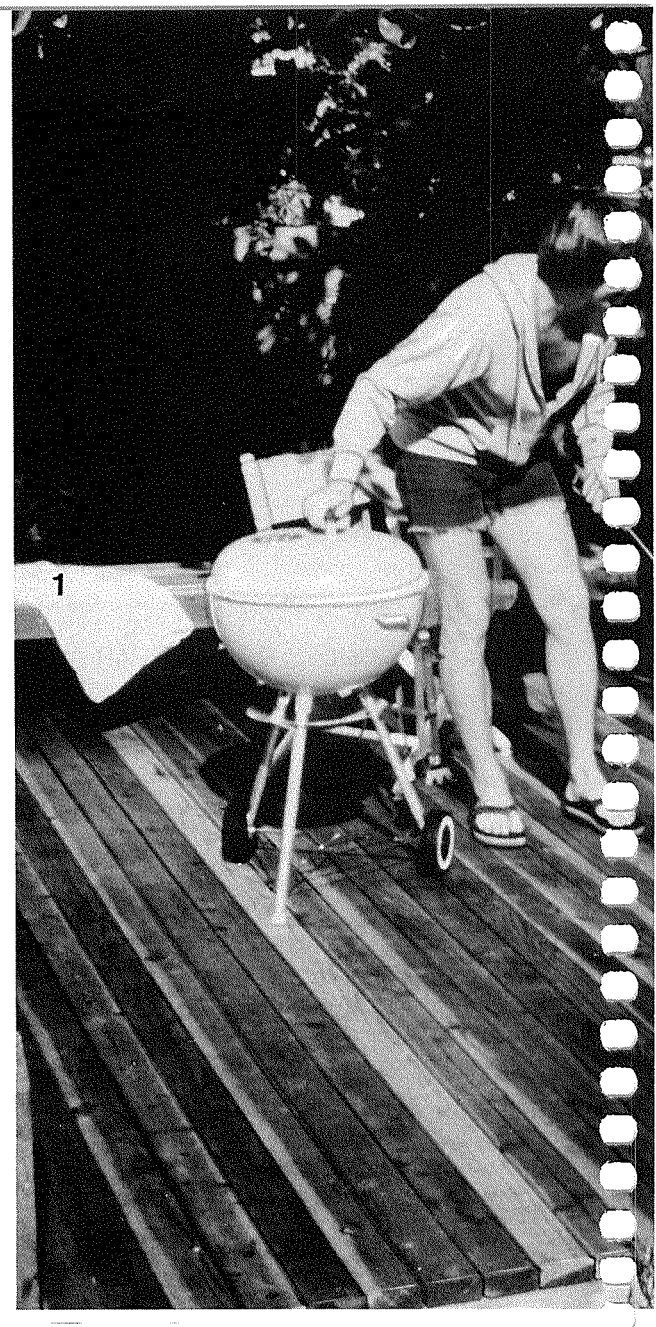
CONCEIVED AS outdoor baths, hot tubs—focus of that status and glamour fad from California—are now being installed across the country, even in the coldest climates. A typical hot tub is built of redwood, equipped with a heater to bring water temperature up to 105°F, a filter pump and a hydrojet pump to provide tub occupants with a massage effect. Tubs are available in a number of sizes from 4 to 8 ft. in diameter and from 3 to 6 ft. deep. Our version, 6 ft. in diameter by 4 ft. deep, is by California Cooperage.

Here are some points to consider regarding a hot tub:

- You can install one in a relatively small space, or on hilly property—in short, where you can't install a swimming pool.
- There is general agreement that a hot tub does have therapeutic value. Users and makers claim that the hot water and jet streams do, in fact, relieve muscle and arthritis pains. In fact, if your doctor prescribes a hot tub for health reasons, its cost and installation just may qualify for a tax deduction.
- Using a hot tub is a relaxing and pleasant experience. Despite the sexual connotation widely employed in promoting hot tubs, the principal hot-tub users appear to be families who jump in and share the relaxation.

picking the location

A hot-tub installation can consist of simply parking one in your yard. But most choose to make the hot tub their outdoor family fun center. Thus, decks are usually installed to provide seating, gathering and dining areas. The tub shown, though home-assembled, is factory-made.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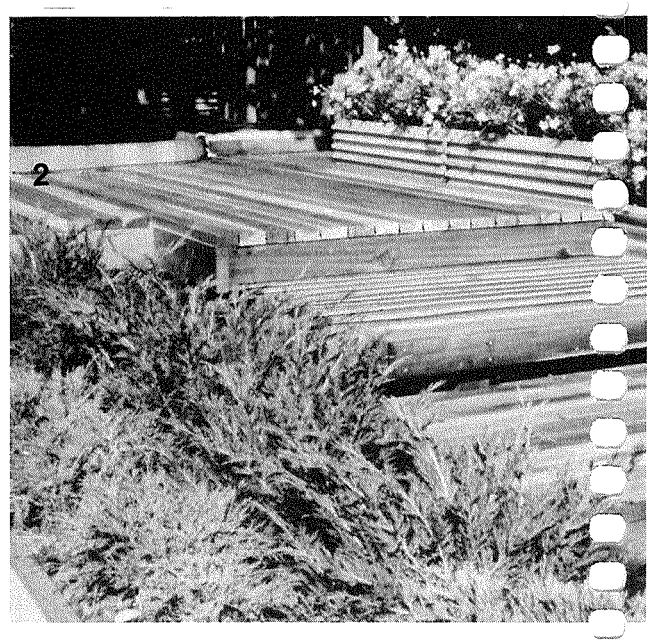
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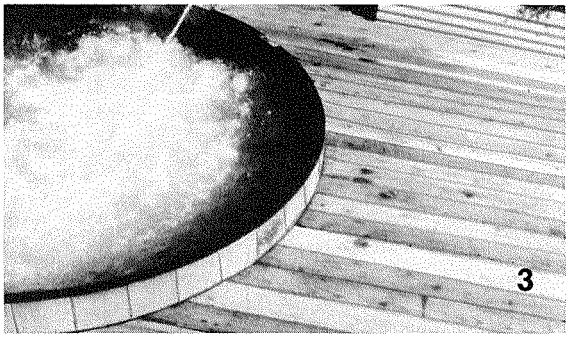
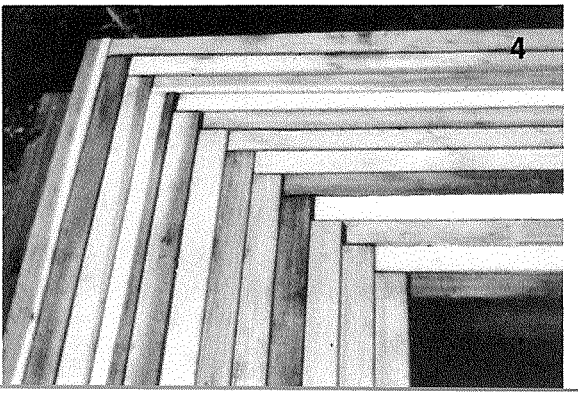
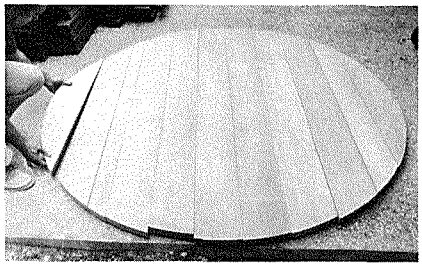
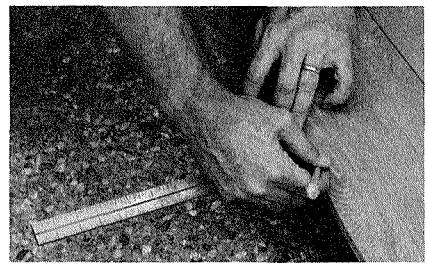
1. A SATURDAY night bath in a hot tub surrounded by a handsome redwood deck—turning a small back yard into the family entertainment center. 2. Elevated decking plan includes planters and fencing. 3. Decking abuts tub around its circumference. 4. Benches are spiked-together lengths of 2x4 redwood.



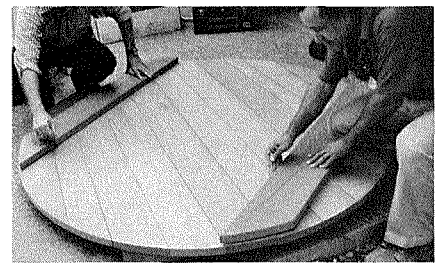




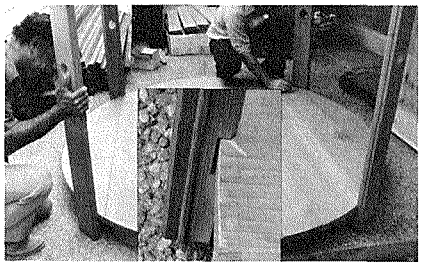
FACTORY-NUMBERED boards prevent assembling the tub bottom improperly.



INSIDE circumference line is accurately drawn ⅜ in. from edge (at bottom).

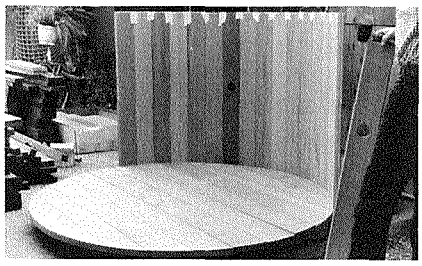


STAVES for plumbing connections are located after determining seat locations.

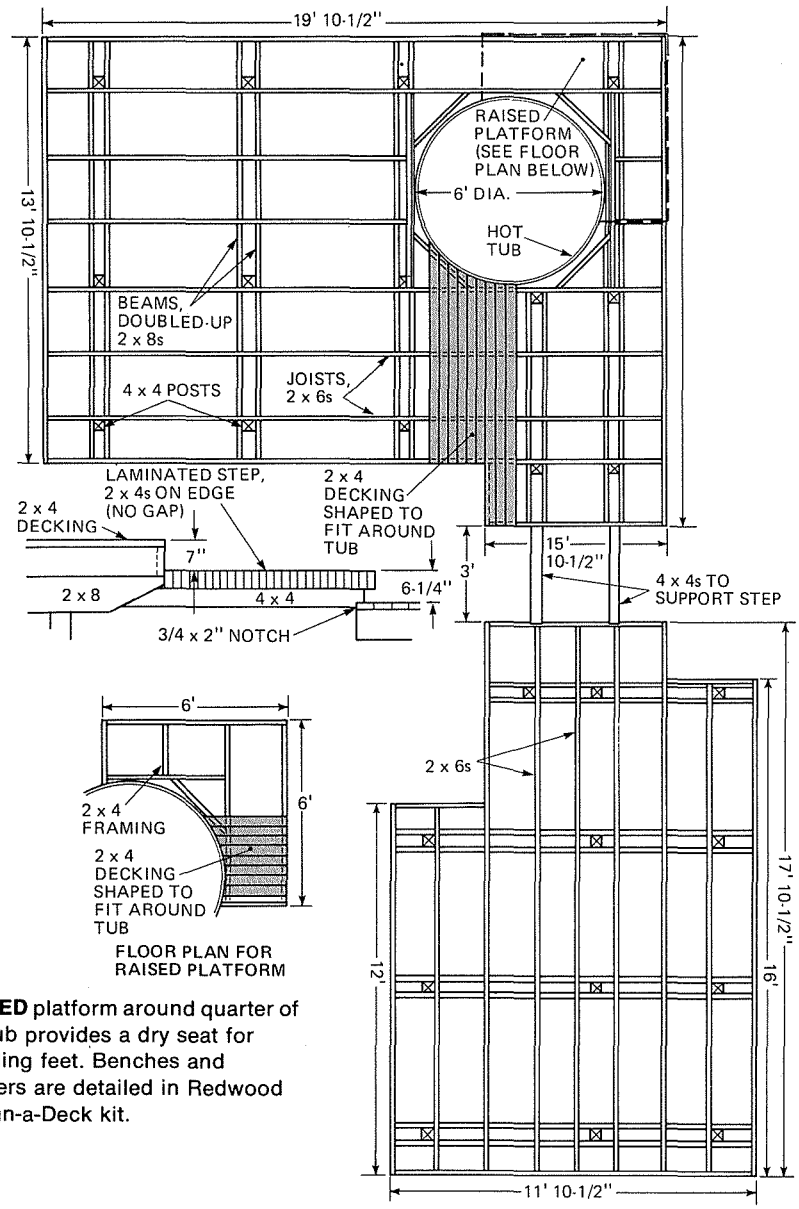


EACH STAVE is tapped with a mallet, so that slot engages (inset photo).

AS EACH stave is placed, masking tape is used to hold a member temporarily.



PARTIALLY assembled tub, with its staves held together by masking tape.



RAISED platform around quarter of the tub provides a dry seat for dangling feet. Benches and planters are detailed in Redwood Design-a-Deck kit.

SHOPPING INFORMATION

Hot tub by California Cooperage, Box E, Dept. PM, San Luis Obispo, CA 93406; **Plantings** by Palos Verdes Begonia Farm, 4111 242nd St., Walteria, CA; **Deck, benches and planters** of garden-grade California redwood.

Start by carefully laying out your entire yard in scale on graph paper. If your tub will be incorporated into a deck, make a floor plan sketch and indicate all dimensions on it. In order to determine the best location for your hot tub, consider these points:

- Esthetic values. The tub should look pleasing; to emphasize the point, don't park it next to a compost heap, for example.
- Convenience and privacy are also important. Chances are, you will want it reasonably close to your house, and you obviously want it shielded from neighbors' view. (Ed. note: Purists use their hot tubs sans bathing suits.)
- Exposure to wind, sun and shade should also be taken into account before setting up the tub.
- Perhaps most important when picking a location is power supply. Your tub will require 220-volt electricity (and gas, if your heater is the gas type). You should plan on using a licensed electrician (and plumber, if gas) to make the final hookups. It is very important that your installation conforms to local code and meets safety requirements. Thus, it makes sense to call in the professionals for these steps.

Also, keep in mind that a tub filled with water is heavy; our 4-ft.-deep by 6-ft.-dia. tub, for example, weighs in at 3000 lbs. when filled with water—more when people are added.

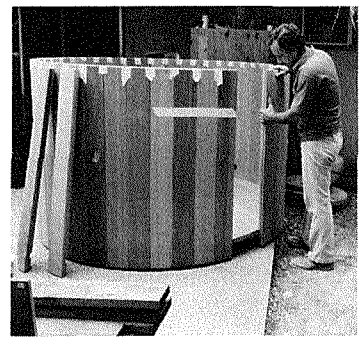
You can sink the tub into the ground, but the experts at California Cooperage advise against it. Their experience shows that burying a tub can bring on complications such as dirt contact, drainage, access to tub plumbing and location of support equipment.

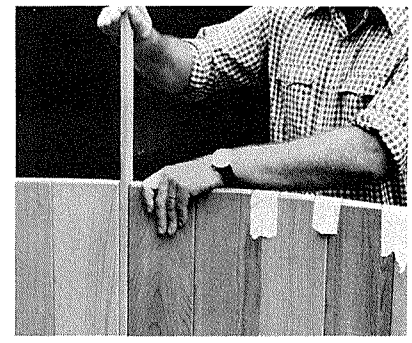
tub assembly

The tub shown on pages 4 and 5 is by California Cooperage. It comes complete as a kit, with easy-to-follow assembly instructions. Parts are numbered and the instructions are written step fashion to keep the assembler in sequence.

Generally speaking, the tub plumbing connections (or the predrilled staves, see photos) are installed on the side of the tub toward the support equipment. The exact placement of these staves, however, depends on how you decide to arrange the two seats inside the tub. The easiest method is to take the seats and lay them out on the tub bottom, facing them as you will want them in the finished tub in relation to their surroundings.

On four-jet models, the stave package includes four staves predrilled for jets and two





MAKE certain each stave is seated tightly against the adjoining one (left). If needed, a final "spacer" stave is force-fitted between first and last staves.

staves drilled near the bottom for tub outlets. Generally, it is best if the hot return line from the heater is connected to the higher jets and the direct return from the pump goes to the lower jets. The maker says this arrangement gives superior water circulation and jet action in the tub.

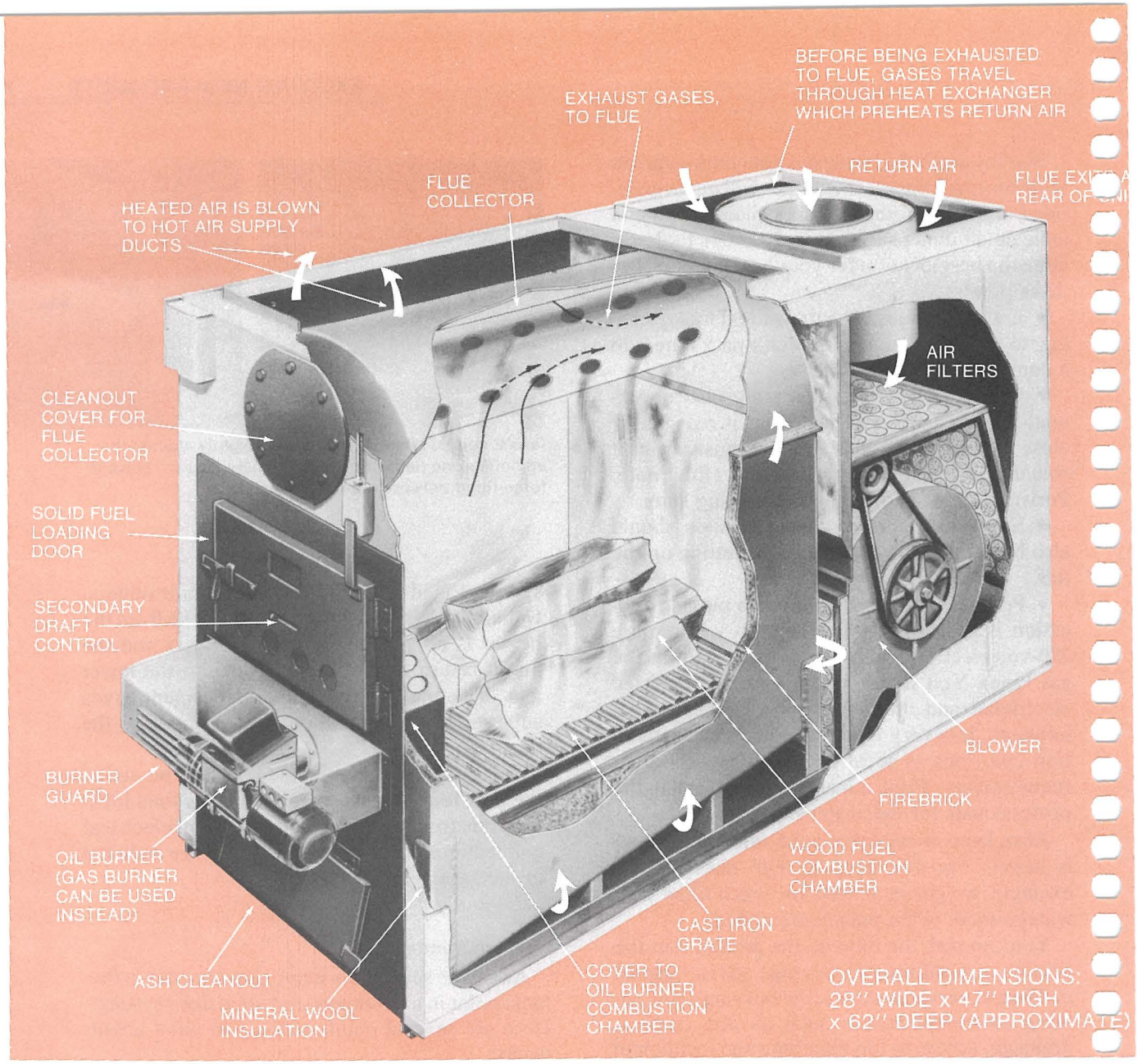
Once the tub is assembled, enlist the aid of three or four helpers to carry it to its final location. Instructions for plumbing and electrical connections and support equipment are included in the assembly booklet.

total environment

As can be seen in the photos, our hot tub is the focal point in a handsome redwood deck setting. Here are several points to keep in mind about decks:

- Most ideas for the deck were taken from the California Redwood Assn.'s Design-A-Deck-Kit. Construction methods in it are simple and no complicated joinery is called for. Write to California Redwood Assn., Dept. PM 379, 1 Lombard St., San Francisco, CA 94111.
- To save money, our deck is built of garden-grade redwood, rather than clear all-heart. The lower-cost grade is a stable wood that naturally resists warping, checking and cracking.
- Because the tub shown is built in a temperate area, designer O'Grady assures that the tightly fitted 2 x 4s (used to form the butcherblock steps and benches) work just fine. If you live in an area subject to frost, however, you should leave some space between boards for positive water runoff.

For more information on hot tubs—models available, costs and so forth—write to California Cooperage at the address shown on page 6.


BEFORE BEING EXHAUSTED TO FLUE, GASES TRAVEL THROUGH HEAT EXCHANGER WHICH PREHEATS RETURN AIR
EXHAUST GASES, TO FLUE
RETURN AIR
FLUE COLLECTOR
HEATED AIR IS BLOWN TO HOT AIR SUPPLY DUCTS
AIR FILTERS
CLEANOUT COVER FOR FLUE COLLECTOR
SOLID FUEL LOADING DOOR
SECONDARY DRAFT CONTROL
BLOWER
BURNER GUARD
FIREBRICK
OIL BURNER (GAS BURNER CAN BE USED INSTEAD)
WOOD FUEL COMBUSTION CHAMBER
CAST IRON GRATE
ASH CLEANOUT
COVER TO OIL BURNER COMBUSTION CHAMBER
MINERAL WOOL INSULATION
OVERALL DIMENSIONS: 28" WIDE x 47" HIGH x 62" DEEP (APPROXIMATE)

MULTI FUEL FURNACE. Cordwood up to 22 in. long is loaded into the primary combustion chamber while power to oil or gas burner is off. When the burner is turned on, it ignites the wood, then shuts off when the chamber temperature reaches a preset minimum, allowing the wood alone to maintain home temperature. Gas or oil take over if fire dies down.

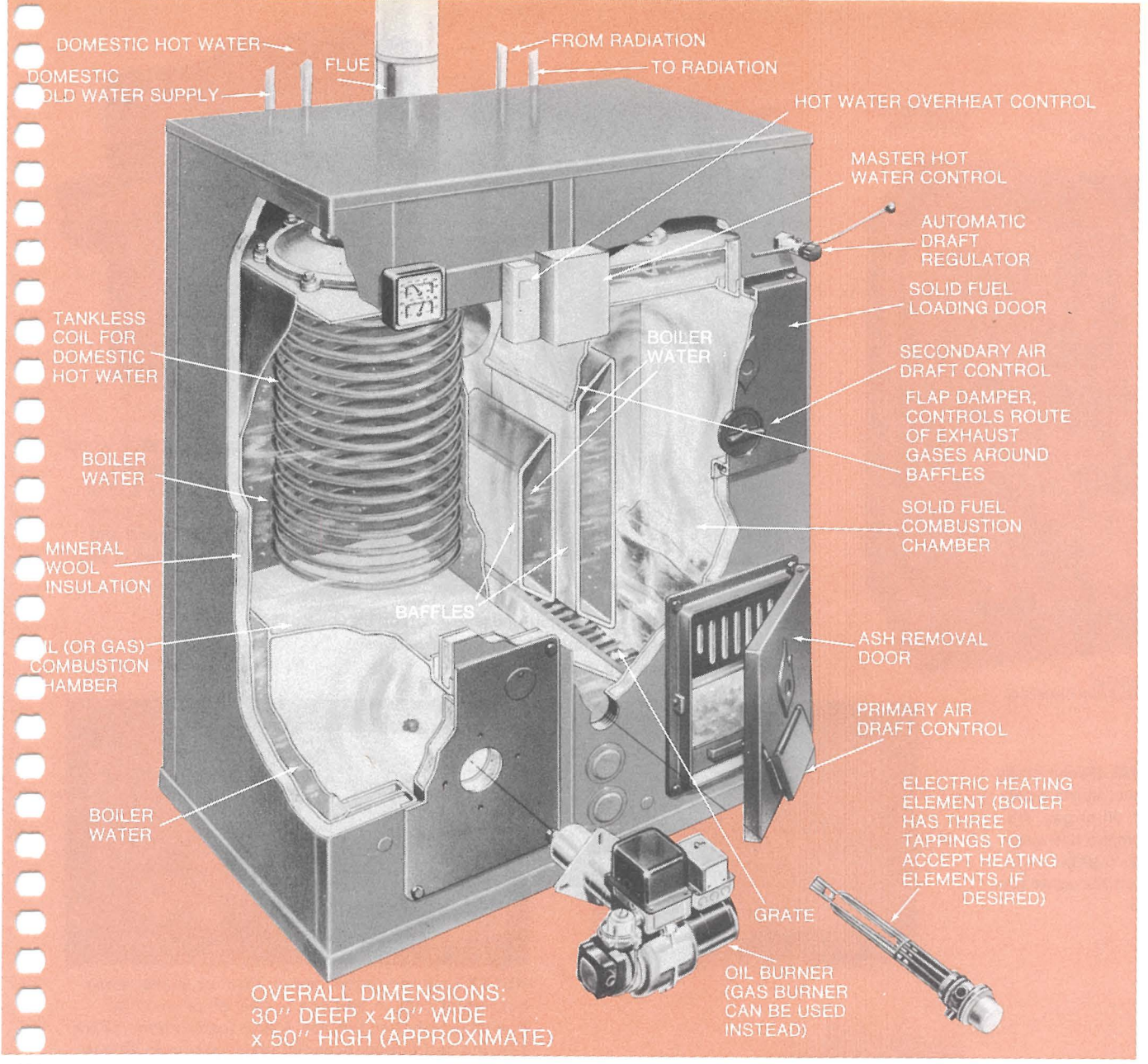
New furnaces let you choose your own fuel

By JOSEPH R. PROVEY

■ "DO YOU MEAN to tell me that those things really exist?" That's what most people say when they're told about multifuel central heaters. Such heaters not only exist, but they exist in a proliferation of designs that are heralded by their makers with a barrage of claims. This article will help put multifuel units in perspective for the reader who is thinking about buying one.

A multifuel heater is a furnace or boiler which will burn some combination of fossil and solid fuels. A typical unit will burn oil or gas, plus wood or coal. Some units can even operate on electricity, while others are restricted to wood, plus oil or gas.

The heat distribution system for multifuel units is the same as for conventional forced-air, hot-water and steam heaters. Installation is not



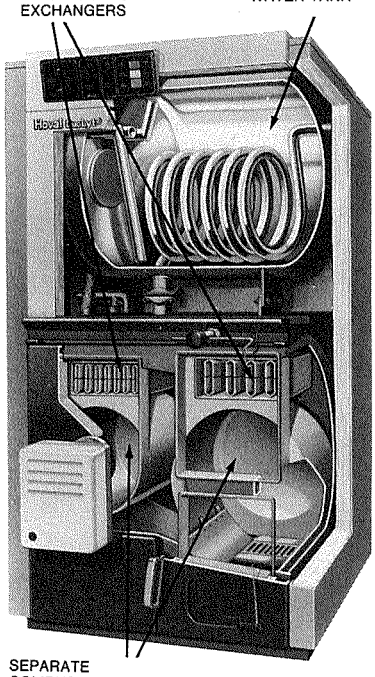
MULTIFUEL BOILER. Hot-water boiler with independent combustion chambers efficiently burns gas or oil on one side, coal or wood on the other. Chamber walls transfer heat to surrounding water, which is pumped to radiators as needed. If solid-fuel fire dies down, oil (or gas) burner will kick in. Electrical heat elements can also supplement solid fuel.

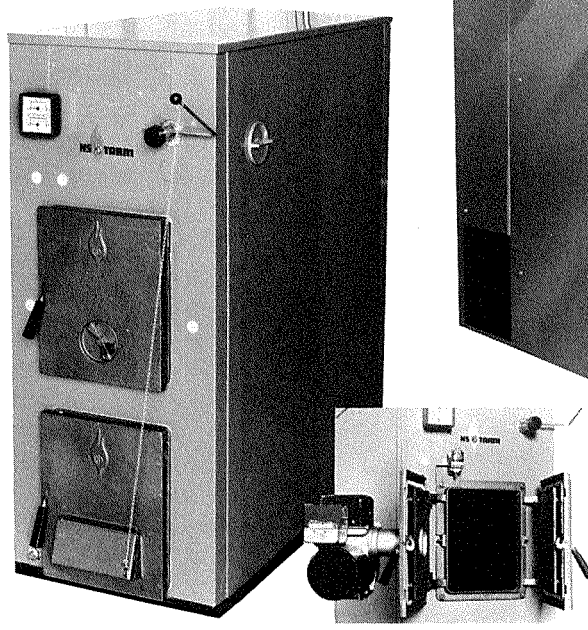
complicated. Most units can be connected to existing house thermostats and Class A chimneys (tile-lined or insulated stainless steel) which are in good repair. Existing flues for gas-fired furnaces and boilers may not be adequate for multifuel units—check manufacturer's specifications and your local building code before you buy.

A multifuel heater is usually hand-fired with solid fuel. To do so, a homeowner must turn off the electric current to his oil or gas burner and feed the combustion chamber in much the same way he would a coal- or wood-burning stove. The solid-fuel chamber of most units is equipped with an automatic draft set to keep the fire at an even temperature. If the fire gets too hot, the damper closes to reduce the air supply and retard combustion. If it begins to cool, the damper opens to let in more air. In some units, the primary air is supplied by a small thermostat-activated blower.

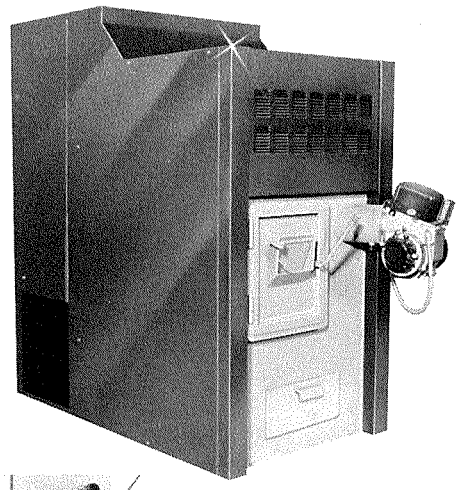
Multifuel heaters are set up so that when the solid-fuel fire cannot meet the demand because the fuel has dwindled, the automatic gas or oil burner switches on and takes over. Some units, usually those that have single combustion chambers for both solid- and fossil-fuel burning, are designed primarily to burn solid fuel. The oil or gas burner on such units is a backup, to be used when you are away and can't feed-in solid fuel.

Units specifically designed for multifuel burning generally have two independent combustion



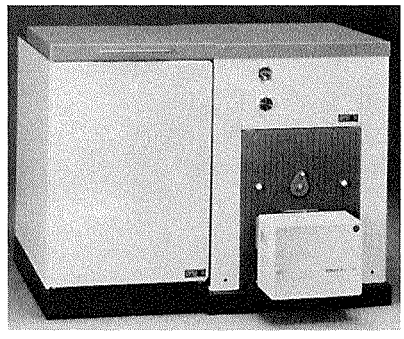


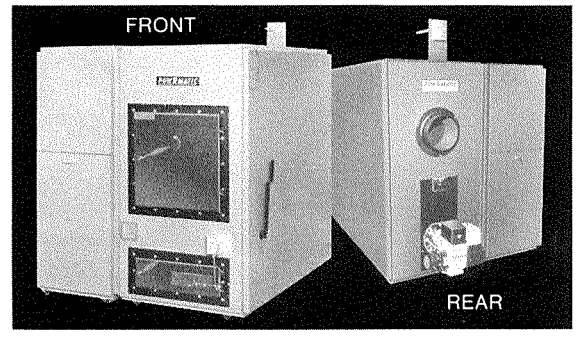
AN OIL or gas burner can be mounted (see inset) on the MB Solo boiler add-on when existing fossil-fuel-type boiler wears out, saving conversion costs.



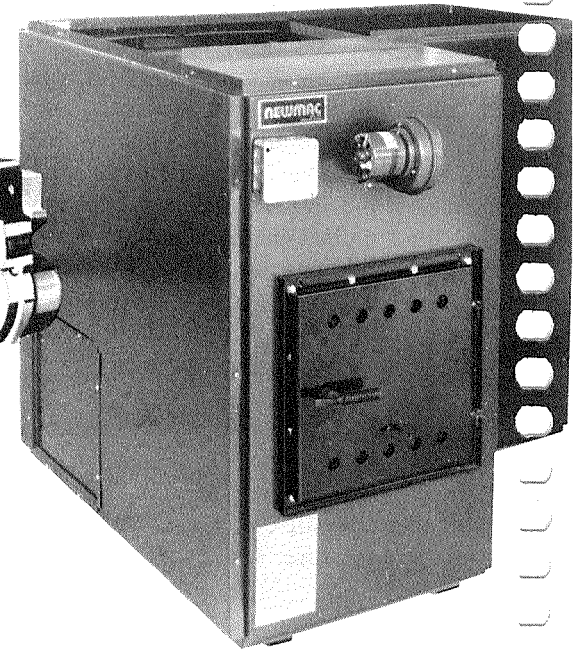
CHARMASTER'S wood/oil/gas combination furnaces with 3/16-in. steel fireboxes come complete, wired and ready to install in your home.

HOVAL Duolyt boiler (above) burns wood, coal, oil or gas. The Polymatic hot-water boiler (right) can be run on the same four fuels.





HEAVY cast-iron grates and an exterior shaker allow burning of coal, in addition to gas, oil or wood in Powrmatic's hot-air furnace. A large loading door (17½ x 17½ in.) and firebox accommodate logs up to 23½ in. long. Shown in the photo on the right is the oil burner which is fastened to the bottom of the unit to supplement solid fuel operation.



LONGWOOD (above and Newmac (right) combination hot-air furnaces differ, in that former burns fuel in same chamber, latter in independent chambers.

chambers. Efficiency on the oil-burning side of two-chamber units is usually higher (5 to 10 percent) than oil-burning efficiency in single-chamber units. Firing into "that big barn," as one manufacturer of oil-burners puts it, tends to promote greater stack loss of heat. Enno Toomsalu, associate managing engineer at Underwriters Laboratories, agrees and states further that two combustion chambers, sized specifically for the fuel to be burned in them, will tend to be more efficient than single-chamber units for burning oil or gas.

The state of Maine has the most active program for testing multifuel furnaces and boilers. Carl Flink, director of the Energy Testing Lab (ETL) at Southern Maine Vocational Technical Institute, says that his facility tests units primarily for safety. A label indicating that a unit was tested and approved by the state of Maine is your best assurance of a safe unit—providing it is installed according to your state and local codes in effect at the time.

At the moment, there is no national program certifying efficiency ratings on the various multifuel units. The only figures you have to go by are those published by the manufacturers—along with the fact that *any unit which is listed by UL or approved by the ETL must be at least 75-percent efficient when burning oil.*

features to consider

The Hoval Duolyt boiler (cutaway shown on page 10), has what the maker calls "thermolytic" heat exchangers. These harmonica-like flue passages collect soot during the start-up and slow-down phases of the heating cycle. As the combustion chambers are fully fired, soot and creosote which have collected are burned off by the extremely high temperatures. These exchangers scrub the exhaust gases clean, allowing the boiler to be run at higher efficiencies (86 to 88 percent when a unit is oil-fired) and at cooler stack temperatures than possible for conventional units.

The Hoval boiler also produces domestic hot water in a way that minimizes lime buildup and scaling. Primary boiler water is pumped through a coil, which transfers heat to a storage tank as required by an aquastat. This allows the homeowner to keep the domestic water temperature below 140° F., the point at which lime begins to accumulate.

The special thermostat available with Oneida's wood/oil combination furnace (cutaway view of furnace on page 8) is another good idea. This thermostat tells the homeowner which fuel he is burning and will be especially helpful in saving fuel oil, since it indicates when solid fuel needs replenishing.

The Charmaster combination furnace (see photo on page 10) does not burn in the same way as most other multifuel units. Instead, it restricts the draft to produce a 4- to 6-inch bed of charcoal, which not only gets the most from the wood fuel, but lets you reload less frequently. The Charmaster unit also saves you sawing and splitting, since the combustion chamber accepts unsplit logs up to 11 inches in diameter and 30 inches long.

Longwood's Dualfuel furnace (photo on page 10) is similar to the Charmaster, because the draft is restricted in an effort to build up a deep bed of charcoal. In this unit, wood and oil (or gas) burn at the same time. The manufacturer claims that this method allows you to heat your home at a ratio of 25 percent oil to 75 percent wood. Oil or gas can also be used exclusively when wood-firing the unit is not possible.

MANUFACTURERS LIST*

For the types of units made by a manufacturer, refer to key:

A: Multifuel forced-hot-air furnace
B: Multifuel hot-water boiler
C: Multifuel steam boiler
D: Solid-fuel furnace add-on
E: Solid-fuel hot-water add-on
F: Solid-fuel steam add-on

American-Energy Marketing Associates Inc. (Simplex Multitherm units), Dept. M, 4642 Crossroads Park Dr., Liverpool, N.Y. 13088; **B, C,** $2900; **E, F,** $2500.

Arotek Corp. (Newmac and Hoval units), 1703 East Main St., Torrington, Conn. 06790; **A,** $975-$1800; **B,** $2500-$3900; **D,** $800; **E,** $1800-$2900.

Charmaster Products Inc., 2307 Highway No. 2 West, Grand Rapids, Minn. 55744; **A,** $1700-$1900.

Combo Furnace Co., Div. of Northern Heating, 1707 West Fourth St., Grand Rapids, Minn. 55744; **A,** $1400-$1500; **B,** $1800-$1950; **D,** $900.

Daka Corp., Industrial Park, Pine City, Minn. 55063; **D,** $400-$850.

Decton Iron Works Inc. (Russell Stove), 21385 West Good Hope Rd., Lannon, Wis. 53046; **D,** $700.

The Defiance Co., Chassell, Mich. 49916; **D,** $795.

Franco-Belge Foundries of America Inc., 70 Pine St., New York, N.Y. 10005; **B,** $2300; **E,** $1200.

Johnson Energy Systems Inc., 7350 North 76th St., Milwaukee, Wis. 53223; **D,** $289-$580.

Kickapoo Stove Works Ltd., Box 127, LaFarge, Wis. 54639; **D,** $400-$500.

Longwood Furnace Corp., Gallatin, Mo. 64640; **A,** $2000-$2200.

Monarch Ranges and Heater, Div. of Malleable Iron Range Co., Beaver Dam, Wis. 53916; **D,** $360 and up.

National Stove Works Inc. (Thermo Control units), Box 640, Cobleskill, N.Y. 12043; **D, E,** $800-$900.

Oneida Heater Co. Inc., Oneida, N.Y. 13421; **A,** $1400-$2000.

Powrmatic Inc., 2906 Baltimore Blvd., Finksburg, Md. 21048; **A,** $1700.

Ram Forge, Brooks Me. 04921; **E,** $655.

Riteway Manufacturing Co., Box 153, Harrisonburg, Va. 22801; **A,** $1500-$3200; **B,** $1600-$4400.

Shenandoah Manufacturing Co. Inc., Box 839, Harrisonburg, Va. 22801; **D,** $525.

Sam Daniels Co. Inc., Box 868, Montpelier, Vt. 05602; **A,** $2000-$3000; **D,** $1300-$2300.

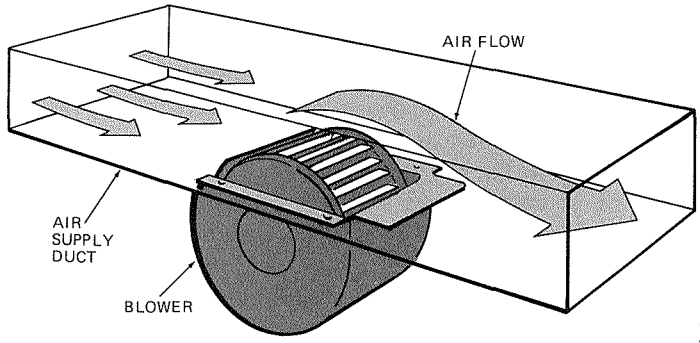
Suburban Manufacturing Co., Box 399, Dayton, Tenn. 37321; **D,** $550-$575.

Tekton Corp. (HS Tarm units), Conway, Mass. 01341; **B,** $2050-$3100; **E,** $1500-$2200.

*Units listed have not been tested or endorsed by Popular Mechanics. Research the unit of your choice thoroughly before you buy. Note that all prices are approximate and subject to increases—and that they do not include installation costs.

Add-on blower heats farthest rooms

By JOHN E. GAYNOR

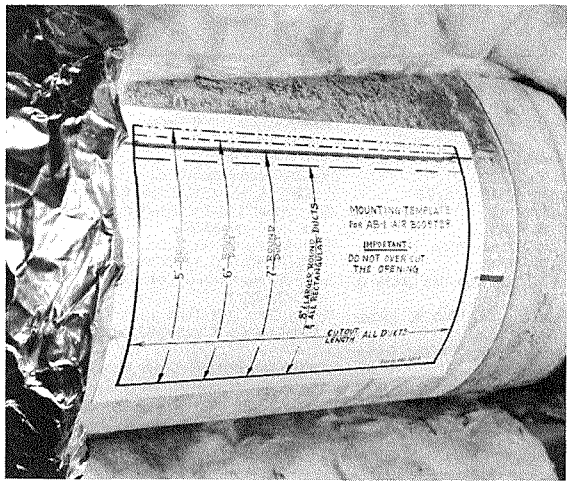


AIR-BOOSTER has a heavy-gauge housing that attaches with sheet-metal screws over a hole cut in duct.

■ HOMEOWNERS with central heated and cooled air systems often find that the room farthest from the system's blower doesn't receive enough heated or cooled air. The air seems to come out of the room register in a trickle. No matter what season it is, the room is never properly heated or cooled.

The Air-Booster is an add-on blower designed to increase both velocity and volume of air to a room that's in need. Rubber motor mounts make the unit run extremely quietly. When the booster is wired parallel to the central system's blower motor, the Air-Booster operates simultaneously with the central blower. It can also be operated apart from the central system with a thermostat (purchased separately at a heating supply house or dealer), or operated manually on another circuit with an on/off switch whenever you want it. For greatest air movement to the problem room, the manufacturer recommends that the booster be installed on the duct nearest to the trunk supplying the room. The motor shaft must always be in a horizontal position.

A SELF-ADHESIVE template in the kit serves as a guide for cutting a hole in the duct.



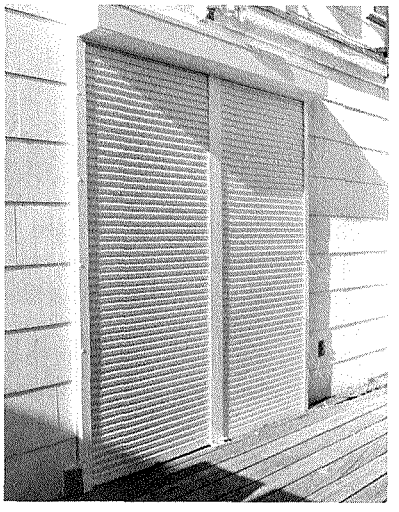
The booster can easily be installed by a do-it-yourselfer. It comes with complete instructions. The kit also contains a self-adhering template with outlines for cutting various-size ducts, either round or rectangular. You cut a hole in the duct, fasten the unit in the opening, and then connect the unit's wiring to a power source. Don't forget to wear safety goggles while boring and sawing the duct.

The manufacturer recommends oiling the motor once every six months with SAE 20 oil for normal operation and every two months for continuous operation. Although not convenient, it can be oiled with an eye dropper and a small mirror. The benefit of a properly conditioned room more than offsets the inconvenience.

Cost of the Air-Booster is about $45; extra wiring is about $4. Steinen of Carolina, Inc., Airport Rd., Kinston, N.C. 28501 makes it.

Rolling shutters help cool your home

By STEFAN E. BRETT



EXTERIOR-MOUNTED rolling shutters cover this 6-ft.-wide sliding glass door between den and deck. Shutters lower heat gain in summer, heat loss in winter, protect glass from hail and afford full privacy.

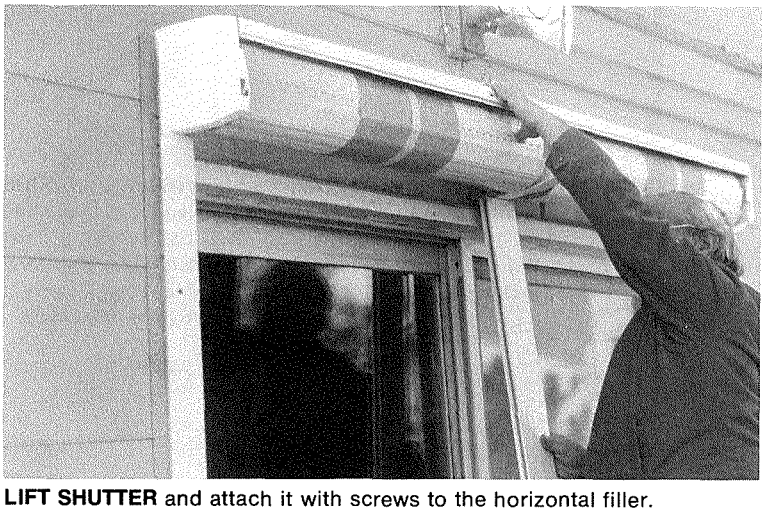
■ PROBLEM: How do you cover a 6-ft.-wide, sliding-glass den door with something decorative and energy-saving? Solution: New Pease rolling shutters, which are installed outside the door, but can be operated from inside the room.

The shutter, made by the Pease Co., Ever-Strait Div., New Castle, IN 47362, conserves energy by trapping air between itself and a window (or glass door), thus creating a dead-air space which serves to insulate the room. The shutter is made of hollow PVC extrusion—another dead air space which helps to insulate.

In hot weather you can close the shutters during the day to prevent radiant heat entering. Open the shutters at night after the temperature drops to admit cool evening air. In cold weather, open the shutters during the day; close them at night.

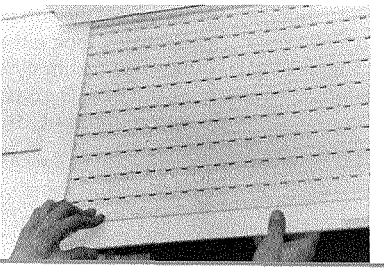
Shutters are available in sizes to fit double-hung or sliding windows and patio doors. Prices range from about $175 for individual window shutters to $400 for ones to cover sliding doors, as shown.

FROM LEFT: Nail ¾-in.-thick strips at sides and top of door. Test-position shutter rails on strips, using a level to plumb. Bore holes in wood strips and attach shutter rails. Locate place for strap to operate shutter; bore through wall.

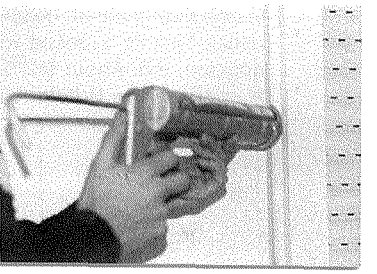


LIFT SHUTTER and attach it with screws to the horizontal filler. Here, two shutters separated by a center post are used.

AFTER installing the hand strap mechanism to operate shutters, thread the slats in the side rails; secure top cover.



FINAL step of the installation is caulking the top and sides of the perimeter to seal the unit.



Make it tougher for burglars!

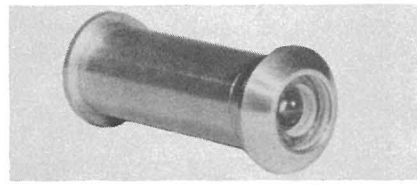
By JOSEPH PROVEY

■ IT'S A GOOD BET that a professional burglar can get into the average home in less than 10 seconds. There are, however, many products to help you slow him down long enough to discourage him or maybe even scare him away before he gains entry.

Start at doors, where burglars usually try first. If you have an extra two or three hundred dollars, spring for a steel-encased door with a steel or steel-reinforced wood frame. Second in importance to the door's composition is its lock. Basic security requires that cylindrical or tubular locks *at least* have a deadlocking latch bolt—a small auxiliary plunger that locks the latch in place. Even better would be the addition of a deadbolt lock.

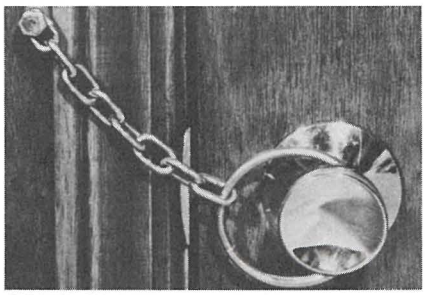
Foiled at your door, a burglar might try a window, basement vent, garage or patio door. A keyed deadbolt lock on a sliding door beats a broom handle wedged in the door's track, since it can't be flicked out of the way with a snaked-in coat-hanger wire. The key, however, should be left hanging nearby for quick exiting. Deadbolts are also available for sliding, awning and double-hung windows you want burglarproofed.

SECURITY-3 system ($195 to $370) uses steel door, steel-reinforced frame, latch, three deadbolts and self-locking hinges. Knob disengages locks. Pease Co., 7100 Dixie Hwy., Fairfield, OH 45023.

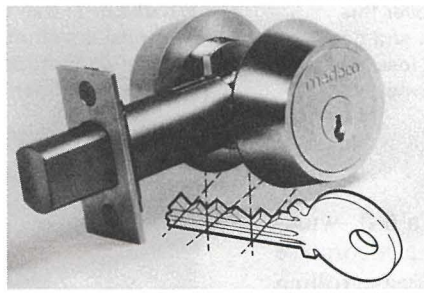


EASY-TO-INSTALL, one-way, viewer has a fish-eye lens, lets you see who's at the door. Fits doors up to 2⅛ in. thick. About $3.90 from Hager Hinge Co., 139 Victor St., St. Louis, MO 63104.

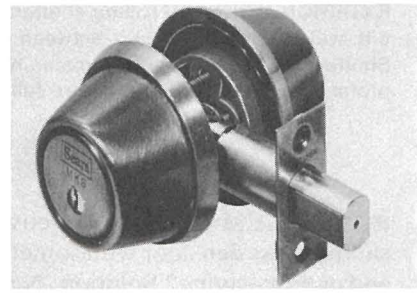
DOOR SECURITY HARDWARE



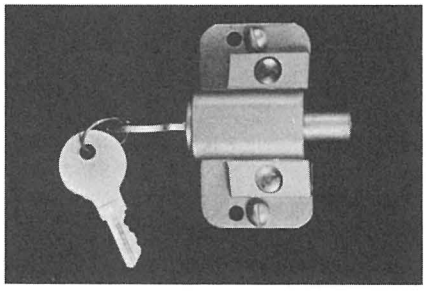
CHAIN-GUARD deters intruders with knob-ring design and casehardened chain secured with a 3-in. lagscrew. About $3 from Better Way Products, 21330 Center Ridge Rd., Rocky River, OH 44116.



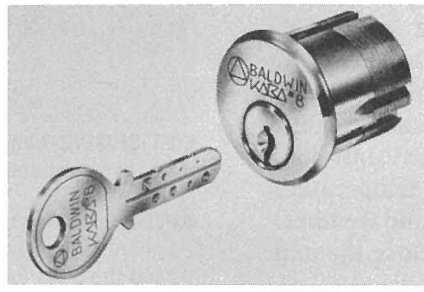
NEW HIGH-SECURITY deadbolt lock by a leader in pick and drill-resistant cylinders has 2-in.-long, hardened steel antisaw bolt with 1-in. bolt throw. $48 to $63. From Medeco Security Locks, Inc., Box 1075, Salem, VA 24153.



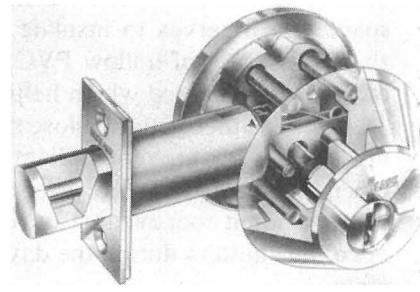
CYLINDER of Sears's MKS match key system lets you reprogram your lock to any of 1000 combinations. It can be used with this heavy-duty deadbolt or other type locks. Replacement Cylinder costs $7; with deadbolt, $15 to $17.



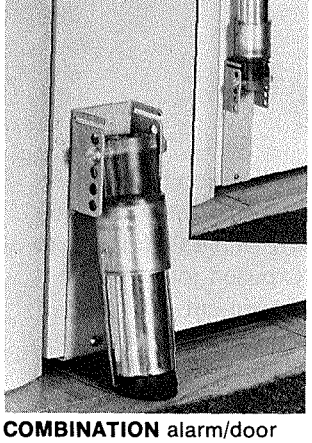
PATIO DOOR BOLT, mounted on edge of inside sliding panel, deadlocks to outside panel. There's a locked ventilating position, too. About $6.70 by Stanley Hardware, New Britain, CT 06050.



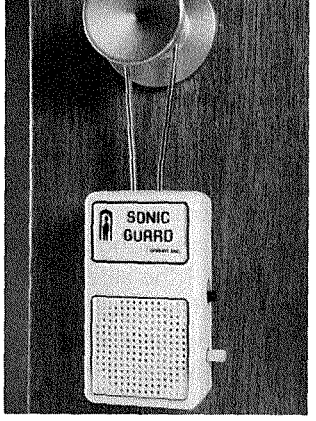
KABA 8 high-security cylinders deter lock pickers. Key with precisely-milled dimples operates lock either way it's inserted. Mortise or rim cylinders with two keys, about $23. By Baldwin Hardware, 841 Wyoming Blvd., Reading, PA 19603.



B500 SUPERBOLT has 1-in. throw and bronze alloy security cover that's wrench-resistant and anchored with hardened bolts. From locksmiths at about $34. Schlage Lock Co., 2401 Bayshore Blvd., San Francisco, CA 94134.

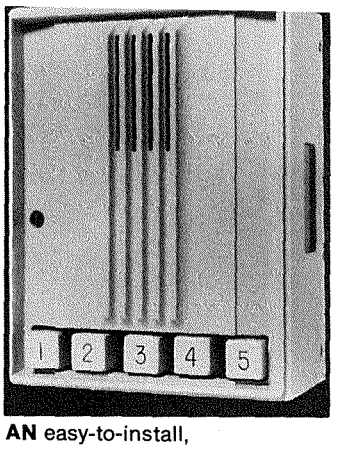


COMBINATION alarm/door stop powered by aerosol container emits a 90-decibel blast when would-be intruders attempt to force door. Priced under $10, it's made by Sunbeam Appliance Service Co., 5300 West Roosevelt Rd., Chicago, IL 60650.



PRE-INTRUSION alarm is designed to scare off an intruder before entry. The battery-powered alarm sounds for as long as the knob is touched. It sells for about $25. Unisen Inc., 17951 Sky Park Circle, Irvine, CA 92714, makes the unit.

A BATTERY-OPERATED Entry/Alert sets up a detection field in and around a metal doorknob. Unit is ideal for travelers, as well as homeowners and apartment dwellers. It sells for about $20. Entry/Alert, 6241 Yarrow Dr., Carlsbad, CA 92008.

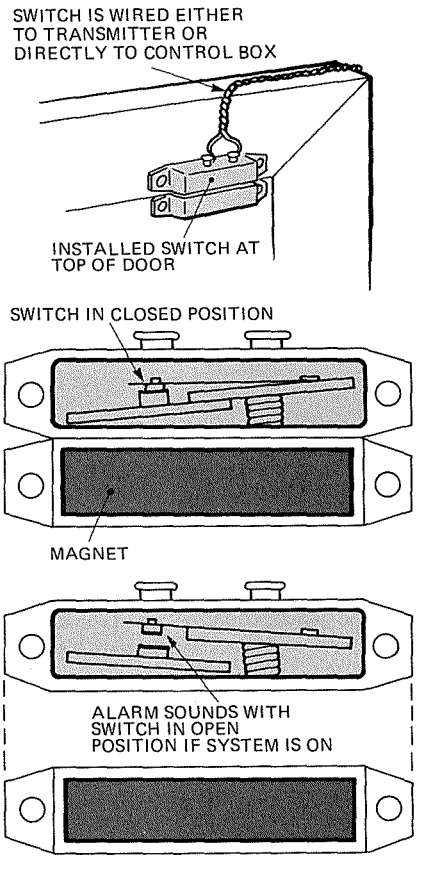


AN easy-to-install, battery-operated Burgalert is armed by entering a five-digit code and disarmed by re-entering code. May be used at door or window. Omtronics Manufacturing Inc., 910 Skokie Blvd., Northbrook, IL 60062. About $40.

POINT-OF-ENTRY ALARMS

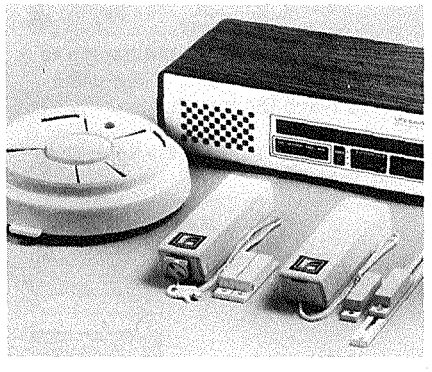
HOME ALARM SYSTEMS

EASY-TO-INSTALL wireless system ($200) provides two magnetic switches, two transmitters, a smoke alarm and a receiver/alarm control box. Extra components available. Chamberlain Manufacturing Corp., 845 Larch Ave., Elmhurst, IL 60126.



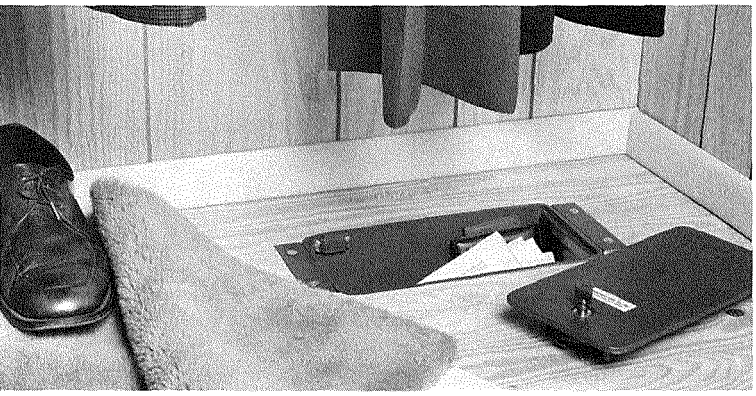
WHEN MAGNETIC detection device is tripped, protective circuit is broken, causing a nearby transmitter to signal a remote receiver or else causing a relay in control box to latch shut and sound the alarm in a hard-wired system.

GUARD SITE uses radar to protect area in home through which intruder must pass to get to your valuables. To install, simply plug it in and connect bell. About $200, from Casady Engineering Assoc., 560 Alaska Ave., Torrance, CA 90503.



LIFESAVER IV includes door and window alarm/transmitter, smoke detector and a.c.-powered receiver. Alarms transmit to receiver up to 200 ft. away. About $200. Golin Communications, 500 North Michigan Ave., Chicago, IL 60611.

EASY-TO-INSTALL Watchman system features a two-stage alarm. Audible beep sounds first. Then, unless it's deactivated due to false alarm, a loud 6-in. bell rings. It sells for about $200. Orient-Martin Inc., Concord, CA 94520.



FLUSH with the floor and hidden under a rug, this safe helps promote peace of mind.

Install a safe in your floor

By ROSARIO CAPOTOSTO

■ YOU CAN SECURE this steel safe in the floor, and then conceal it with a rug to make it both difficult to move and out of sight. The installation is fairly simple; it took me about an hour to complete.

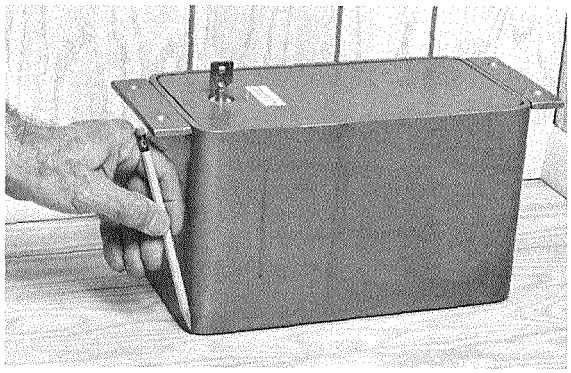
First decide on a suitable location for the safe. A closet floor or a bedroom floor near a corner are both good choices. *Note:* it isn't advisable to install the safe between exposed joists where it could be spotted from a basement.

Locate nearby joists by boring a ¼-in.-dia. hole and probing in it with a bent wire. After you have found a spot for the safe that's between joists, trace the outline of its base on the floor. Bore a 1-in.-dia. hole in each corner of the outline. Make the cutout using a sabre saw with a coarse blade or a keyhole saw. Move from hole to hole to eliminate waste.

Test-fit the safe and trace the outline of the flanges onto the floor. Use a chisel or router to mortise a ¼-in.-deep recess for the flanges. The safe top should rest flush with the floor.

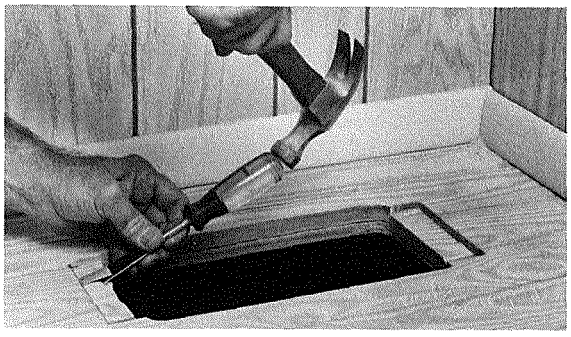
Temporarily reposition the safe. Mark the placement of the Teenuts and screws which secure the unit to the floor. Bore holes and fasten the safe in place.

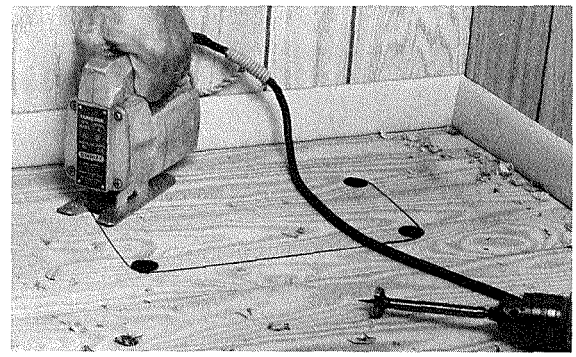
The floor safe is available at locksmith and hardware stores and is ticketed at about $100. For the retail source nearest you, write to: Deerfield Lock Co., 759 Hoffman Lane, Deerfield, IL 60015.



LOCATE the safe between floor joists. Then use a pencil to trace an outline for cutting.

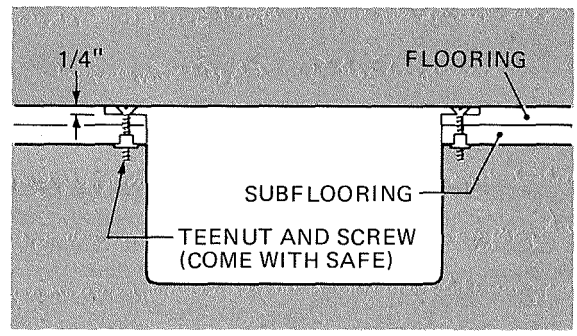
USE A CHISEL or router to cut the ¼-in.-deep mortise for the safe's flanges at the ends.

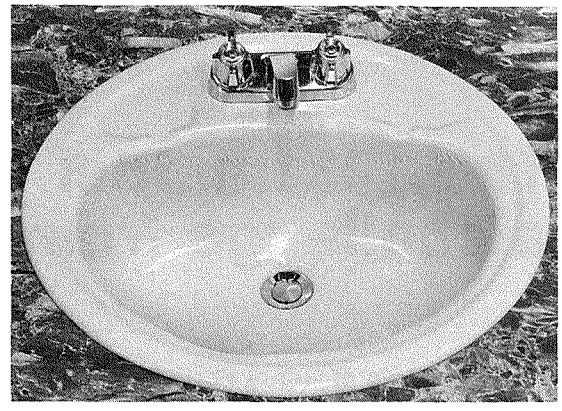




BORE a 1-in.-dia. hole at each corner of the tracing to coincide with the corner radii of the safe. Then use a sabre saw with a coarse blade for cutting.

CHECK that the safe flanges are flush with the floor. Then bore the holes for the Teenuts.





THE KIT contains material needed to refinish a tub or several sinks and a toilet. From left, back row: compressor, spray gun, hose, viscosity meter. Middle: bicarbonate of soda, cleaner, finish, thinner, etcher, gloves, masking tape. Front row: scrubber, roller, patch filler, stir sticks, razor blades, face mask. The finish cures for use in two days.

Refinish a bathtub or a sink

■ THE RENEW-A-TUB process is a do-it-yourself, money-saving alternative to replacing an old chipped tub. It eliminates the mess of ripping out wall and floor tiles and the risk of disturbing and, possibly, damaging the plumbing. The process can also be used to resurface sinks, toilets and kitchen appliances.

We tried it out on a chipped bathroom sink that had mineral stains. Results were quite satisfactory.

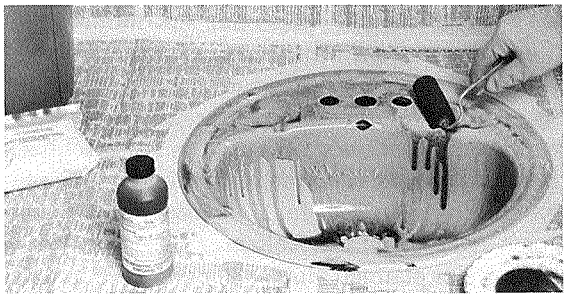
The system involves three basic steps: preparing the surface, patching chips and spraying a finish.

First you remove dirt and soap deposits with a special cleaning solution and scrubber. After cleaning, protect the adjacent areas with newspaper and masking tape. Remove the plumbing fixtures, if possible, or mask them. Next, remove the glaze by using a small foam roller to apply an acid etching solution. Wear a face mask and rubber gloves for this step. Fill chipped areas with a special substance that hardens in two hours. Smooth out small areas with a razor blade; sand larger ones with 220-grit silicon carbide paper.

Mix the finish-coat materials together 30 minutes before you spray. Check the proper consistency with the viscosity meter. Several finish coats produce a hard, glossy surface. To keep the finish in top condition, clean the tub weekly (don't use abrasives), keep the faucet from dripping, don't apply decals or use mats and don't rest soap or other objects on the tub's surface.

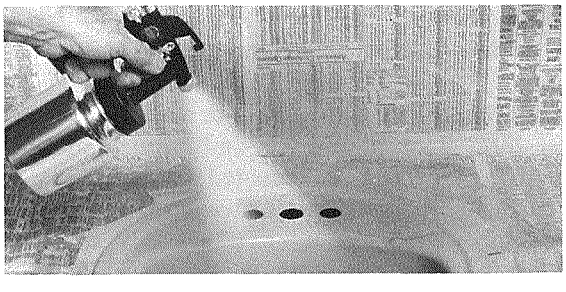
Kits come in white, black, red and major plumbing colors. It's from Spectrodyne Industries Inc., 2005 North Keystone Ave., Chicago, IL 60641. Complete kit covering a conventional tub costs about $110; materials only (no spray equipment) are $70.

AN ACID etch removes all of the original glaze to give "tooth" for the finish coat.



A PATCH filler builds up chipped areas. It is sanded flush to the adjacent areas.

FINISH chemicals are combined and sprayed in coats every 20 minutes to build up the new finish.



The 1981 model year—a challenge from abroad

Since the days of Henry Ford, Detroit has ruled world auto production. Now it is assaulted from every direction—and the motorist may be the winner

By ED NELSON

AS THE AUTO industry moved into what may be its climactic year—1981—auto makers throughout the world were challenging Detroit.

The little old lady in Dubuque, if she decides to trade off her famous relic this year, may find herself with a new engine made by Mitsubishi, or a transaxle made by Isuzu, or a turbocharger by Saab, or even a whole Russian Lada built, of all places, in Canada.

In response to this assault from abroad, Detroit is offering whole new generations of cars.

Ford's new Escort and the K-body cars from Chrysler were designed to stem rising import sales. They joined GM's X-body family of a year earlier.

But looking over the 1981 models tells only part of Detroit's story. More surprises are due later in the model year, with still more waiting in the wings for succeeding years. Even the staid Cadillac division may shock us all.

The K-cars were designed to bring new life to financially troubled Chrysler after federal loan guarantees rescued it from disaster. Financial trouble became worldwide, however. There is some question, as this is written, whether K-car success and Uncle Sam's help together will be enough.

The Dodge Aries and Plymouth Reliant—the K-cars—are barely bigger than the L series Omni/Horizon; the wheelbase is half an inch longer. But they're over two feet shorter and 1000 pounds lighter than the Aspen/Volare which they displaced from the Chrysler lineup. Nevertheless, with the standard bench seat in front, the new cars can take six occupants. And they meet EPA roominess-index criteria for "mid-size" cars. Quite an achievement.

Aries (the name is Latin for "Ram") and Reliant are powered by a 2.2-liter, overhead-cam Four, the first totally new engine Chrysler has produced since the versatile Slant Six of 21 years ago. The new Four is just half the weight of the older product. It has a cast-iron block, aluminum head and intake manifold, and it's mated to a four-speed manual transaxle. An optional 2.6-liter Four is from Mitsubishi.

K-cars' long-hood/short-deck proportions led some observers to compare them to Ford's bigger Fairmont or, more directly, to the notchback Buick and Olds versions of GM X-cars. Essentially only grille and taillight treatments distinguish Aries from the Reliant.

Chrysler planned almost 80 percent of its 1981 volume to be small cars: 43 percent Aries/Reliant K-cars, 26 percent Omni/Horizon L-bodies, and 9 percent Mitsubishi models. By 1983, according to president Lee A. Iacocca, all Chryslers will be front-driven. Other executives saw 1985 as a realistic target.

The name Imperial also has returned to Chrysler's lineup. The '81 car, built in Windsor, Canada, is nearly 20 inches shorter and 800 pounds lighter than its 1975 namesake. It's built on the Cordoba platform.

Ford's front-drive subcompacts

Ford's "Erika" development program has borne fruit in Ford division's Escort and Lincoln-Mercury's Lynx, front-drive subcompacts in three-door hatchback and "four-door liftgate" models. Ford decided it preferred the "lift-gate" term to "station wagon," so Chrysler claims its K-cars include "America's first wagon with front drive in a compact size."

Still more are coming. Ford plans glass hatchback and notchback coupes for mid-'81. Ford's is to be the EXP; Mercury's, the LN-7.

At Escort/Lynx introduction, Ford crowed happily over its 1.3- and 1.6-liter Erika engines. Piston stroke for the 1.6 is 0.6 inch longer, for 23 percent more displacement.

Both are transverse-mounted Fours—"CVH" engines (for Compound Valve-angle Hemispherical head). The combustion chambers aren't true hemispheres, of course, but they're a long step in that direction—probably as long as is practical. The design contributes columetric efficiency. (The ultimate in such efficiency is a sphere; it has the highest possible ratio of volume to surface area.)

Few observers are surprised that Ford, hailing its CVH, pays no tribute to Chrysler's earlier version, the high-performance "Hemi" of the early 1960s.

Ford deserves credit for a breakthrough in CVH valve train design. Rocker arms are on individual fulcrums instead of being spaced along a common shaft. That lets Ford tilt valve stems away from each other at a compound angle to the cylinder center line. The result: room for bigger valves and better engine breathing. Ford sought a European patent.

The engine seems to be growing. Ford already has a 1.8-liter CVH under study and a one-time designer of Ford race cars started work last summer on a turbocharged 1.9-liter version.

The Escort/Lynx advent seemed to finish off both the European-built Fiesta and the Pinto/Bobcat. The Fiesta also had a front-drive transverse-mounted Four and was popular in America. The Pinto was nearly Escort-sized, its wheelbase less than half an inch longer. Well into the introduction season, Ford said little about either of the cars being dropped. Some speculated their sales had been good and the company wanted to keep a last-minute change of heart as an option.

The Escort/Lynx manual transaxle has self-adjusting clutch linkage. It uses lower-viscosity automatic transmission fluid for its lubricant. No automatic transaxle is available with the 1.3-liter engine.

a true "world car"?

GM's biggest news was again expected in mid-year. The J-car series has been gossiped about for months. Few details leaked out before introduction, expected in April or May. The J-cars will be front-drive subcompacts on a 99-inch wheelbase. Japanese sources say that Isuzu Motors, Ltd., GM's Japanese partner, has been asked to supply four- and five-speed transaxles—which suggests a small engine. They are reported due for delivery to GM in the United States, Australia, Brazil, South Africa, the United Kingdom, and West Germany. The list implies GM is building a true "world car," one to sell in many areas at once.

With the mid-year introduction, GM might well follow the pattern it set with the X-cars, presenting the J-car family as "early 1982s." Pontiac and Chevrolet divisions are expected to offer four-door wagons and two- and four-door sedans and hatchbacks. By some reports, even the Cadillac division will offer a little J-car in late '81 or early '82. The standard engine, according to reports, will be a 1.8-liter in-line Four.

Cadillac introduced the variable-displacement engine that Ford tried and set aside. On Cadillac's 6-liter engine, a microprocessor shifts the effective fulcrum of certain rocker arms to close off two or four of the eight cylinders.

Caddy's long-range purpose seems obscure, since it is generally accepted the 6-liter engine will be dropped from the 1982 line. For '81, it's standard on all models except Seville, for which it's an option. Cadillac calls the system "modulated displacement" and describes the engine as a "V-8-6-4."

GM's unique two-passenger car

More exciting are reports of a coming GM car that sounds as though it could be a high-spirited reasonable-cost combination. Chevy's general manager said the division will, by 1982 or '83, have a new, two-passenger car ready—with an electric version by '84. Confirmation was implied in a statement by E.M. "Pete" Estes, GM president, that the corporation will introduce a small electric car by 1984 and sell 100,000 by 1985. Those remarks fit with other talk of a mid-engine, two-passenger car coming from Chevy as a fastback and from Pontiac as a notchback, both as '83s. Style may be similar to the Fiat X 1/9 mid-engine two-seater. The new car will weigh less than 2000 pounds and have four-wheel disc brakes, pop-up headlights, and Pontiac's 2.5-liter Four.

John Z. DeLorean, disenchanted former GM big gun, had said his luxury sports car, the DMC-12, would be introduced in the fall of 1980. He set the timing back to the spring of '81, however, and changed the car's name. DeLorean

Motor Company, instead of selling the DMC-12, will offer the "DeLorean."

For motoring enthusiasts, the Corvette seems due for its first major styling update in years. A sneak peek at a mock-up indicates it will, for 1983, get a more massive, wider looking nose and a wrap-around windshield enclosing the A-pillars.

Pressure from overseas manufacturers continues, however. C. Itoh, Ltd., major Japanese international traders, and Isuzu have formed a U.S. subsidiary, American Isuzu Motors, Inc. It has a $7-million advertising budget and intends to begin in mid-1981 to import 19 car and truck models from Japan. Isuzu has supplied GM with Chevy's LUV pickup since 1971, but the agreement expires at the end of this model year.

turbocharged car from Saab

Perhaps for mid-'81, more likely for '82 models, Saab plans introduction of its APC turbocharger system. Sweden's Saab, originally an aircraft firm, was Europe's first to go with turbocharging on a mass scale. APC (Automatic Performance Control) guards against inaudible but destructive high-speed knock. But instead of retarding spark to forestall pre-ignition, it bleeds off boost pressure. Thus, Saab says, an APC-turbocharged car can burn fuel of nearly any octane and get the best performance it can offer. As ancillary benefits, acceleration improves as much as 20 percent even as economy also gains—up to 8 percent.

Clearly it was time for Detroit to sharpen up. More than one of every four U.S. car purchases are imports. Japanese manufacturers are selling two million cars a year to U.S. buyers.

imports' reputation for quality

Some in Detroit suggest that our purchase of imports amounts to disloyalty, but others concede the imports' reputation for quality. Those from Japan win respect for fit and finish, especially of body parts.

Tough words came from a Federal Trade Commission official: "Too many of our products are poorly designed, badly assembled, and carelessly shipped. We're losing the battle for competitive survival because, all too often, 'Made in U.S.A.' has become a symbol for 'second-rate.'"

Recognition that the challenge is serious comes from within Detroit, too. One executive is impressed with Japanese cars' "auto-show finish." The boss of Japan's branch of GM Overseas Corporation, which brings about 100 Chevettes a month to Japan, concedes standards are such that each must be repainted before it goes on sale.

Lee Iacocca, Chrysler's president, comments, "The adversary is not the union or the government, the way it has been for a couple of decades." He sees competition from the same quarter where others see it: "The adversary in cars is Japan."

The project manager for Ford's severe tests of its CVH engine explains, "We did this because we're out to beat the Japanese in quality right now."

benefits beyond the paycheck

Japanese auto workers' dedication is legendary although their pay is unimpressive. They average $6.85 an hour compared to Detroit's $13.72. But other benefits wed them firmly to the company. Bargain groceries and appliances are often available at a company store. Social life may be structured around one's job. Next to Nissan's super-modern Zama assembly plant is low-cost employee housing where bachelor quarters, for example, go for $16 a month. Absenteeism averages only 4 percent.

Other overseas manufacturers win dedication by integrating employees into operational structures. Some hold small weekly suggestion meetings—on company time. VW's board, by law, is composed of one-third management, one-third worker, and one-third government representatives.

Scandinavian plants use team assembly concepts in which a small team builds one car at a time—completely. This seems to fly in the face of Henry Ford's hallowed assembly-line system in which each worker specializes in a single operation, repeating it over and over, day after day and week after week.

Detroit is trying similar systems to win employee dedication. Chrysler has set up four-member union-management Quality Committees, first at K-car plants, then throughout the corporation. Teams of quality production workers and lower-level management report to the committees.

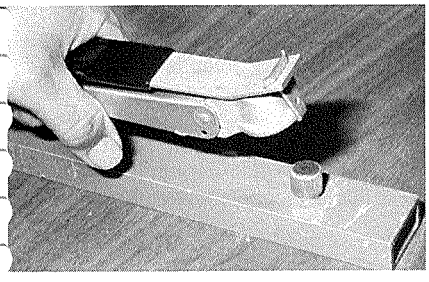
Ford is planning its move. By early descriptions, Ford workers are to report any product flaws to team captains. If the defect could affect later operations or if there is no other way to correct it, team captains have the authority to shut down the line.

All in all, the battle's a fascinating one. And drivers may be the winners.

What's new for your car

MAKE A CLAMP

WORM-DRIVE hose clamps are among the handiest items you can have. Not only are they the best substitute for the cheap clamps that come with coolant hoses, but also for installing circular accessories, as a replacement for the plastic clip that holds the air cleaner snorkel duct, even as a make-your-own balance weight for propeller shafts. You may have put two small clamps together to make one larger one, but you often don't have the right sizes. One manufacturer offers Mak-a-clamp, a kit that includes slotted sections, male segments to fit into the slots, and screw head sections with male segments. The kit, sold for approximately $5 at auto supply stores, lets you make three clamps of almost any size. The manufacturer is Breeze Clamp Co., 100 Aero-Seal Drive, Saltsburg, PA 15681.



WIPER-ARM REMOVER

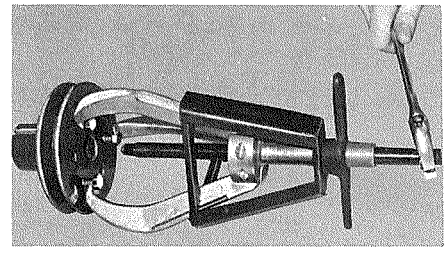
WOULD YOU spend $3 for a tool you might use only once in years, when you can do the job it performs with a screwdriver or two? Take a close look at this one before you say no. It's a windshield wiper arm remover. It has a triangular hook that grabs the end of the arm, and once it's on, you just clamp the tool's handle against the arm (as shown) and lift up. I've gone years without having to pull off an arm, but there have been times I had to do the job twice in a week. This tool works so easily that even if an arm never goes bad, you'll pull it out of the toolbox to show your friends. About $3 from Lisle Corp., Clarinda, IA 51632.

FLEXIBLE NUT DRIVER

NUT DRIVERS are great for turning down finely threaded screws and nuts quickly. Unfortunately, the best applications usually don't offer a straight-on approach that satisfies the driver. A simple answer is a flexible rubber driver that accepts any ⅜-inch-drive socket. It's also possible to use it as a sparkplug starter. The price is under $3 at your local parts store. It's made by Thexton Manufacturing Co., box 35008, 7685 Parklawn Ave., Minneapolis, MN 55435.

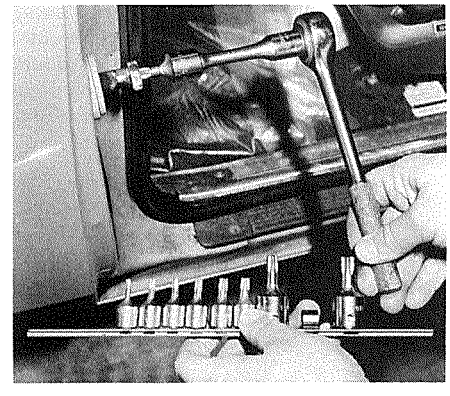
SILICONE CARTRIDGE

THE room-temperature-vulcanizing (RTV) silicone rubber is fast conquering the replacement gasket market. After all, squeezing out a bead of silicone for the thermostat housing, water pump, valve, timing and rear axle covers, oil pan, fuel pump and so on sure beats buying a separate gasket for each. Not only is the silicone cheaper, but it's always a perfect fit and it seals better and longer. Of course, squeezing it out of a toothpaste-type tube isn't the easiest way, and on the factory assembly lines they use pneumatic dispensers. You don't really need anything that elaborate for your own garage, but there is a better way recently introduced: RTV silicone in a cartridge that fits into a caulking gun. Just squeeze the trigger and the bead comes out. The price is under $3 in discount stores.



CAGED PULLER

ONE of the biggest problems with any puller is that the jaws slip off when you turn down the forcing screw. An answer is a puller with a cage surrounding the jaws. Each brace segment of the puller has a guide slot into which the outer side of the jaw fits. This type of puller doesn't have quite the flexibility of the type without the cage. It does do a great job of holding, however, and at $60 and up, it's comparably priced with other medium-size pullers. Octagon Co., Box 3003, Fargo, ND 58108.

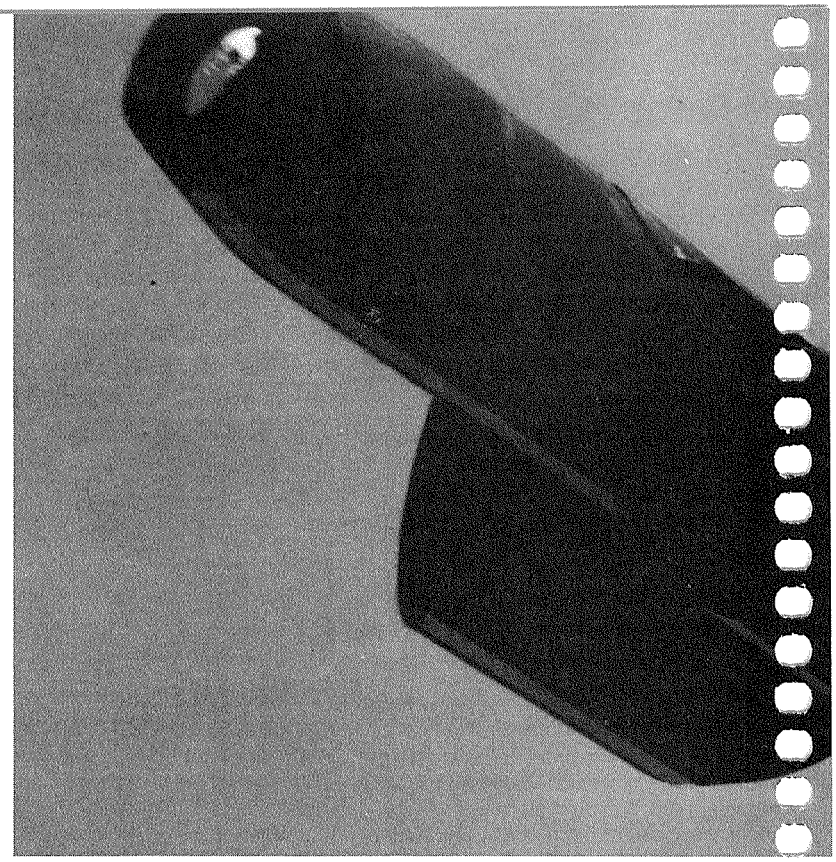


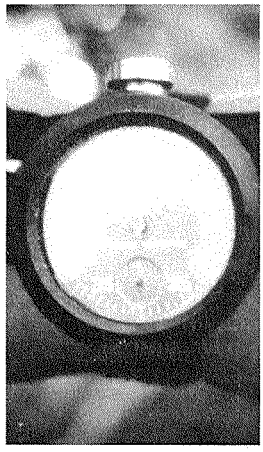
TORX FASTENER SOCKETS

TORX-HEAD screws are coming into wider use on late-model cars and trucks, particularly GM models. The star-shaped, six-sided head is most widely used in internal versions, although external Torx heads also are available. The internal Torx head, like the Allen, permits greater tightening of a roundhead screw than would be possible with a slotted head, even slightly more than with the Allen type. Until recently, about all you saw in parts stores were inserts for socket wrenches, but now you can get a complete set of Torx bits. List price is $30. It's made by Owatonna Tool Co., Owatonna, MN 55060.

Great new gear for underwater fun

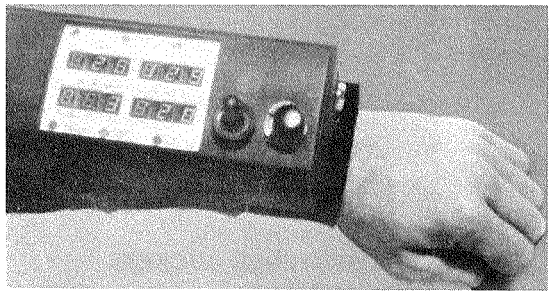
By SHELDON M. GALLAGER

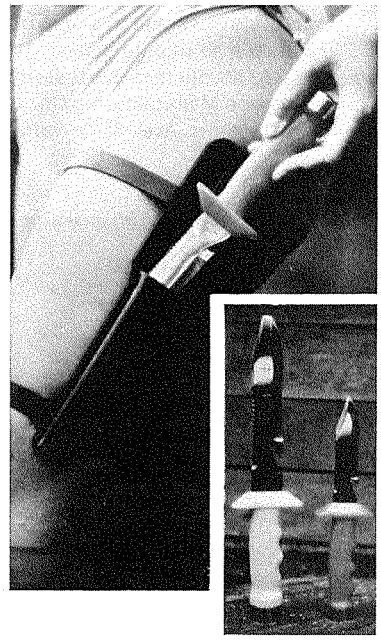


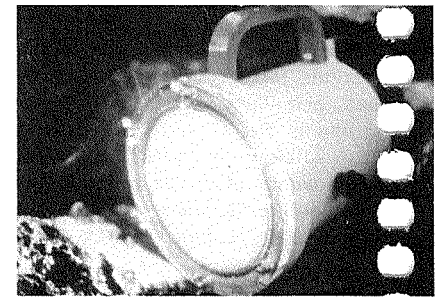


PRESSURE activated Bottom Timer (left) automatically starts as you dive, records elapsed time.

ULTIMATE in scuba instrumentation is Dacor wrist computer (below). Digital readouts tell depth and decompression times, and warn of dangers.





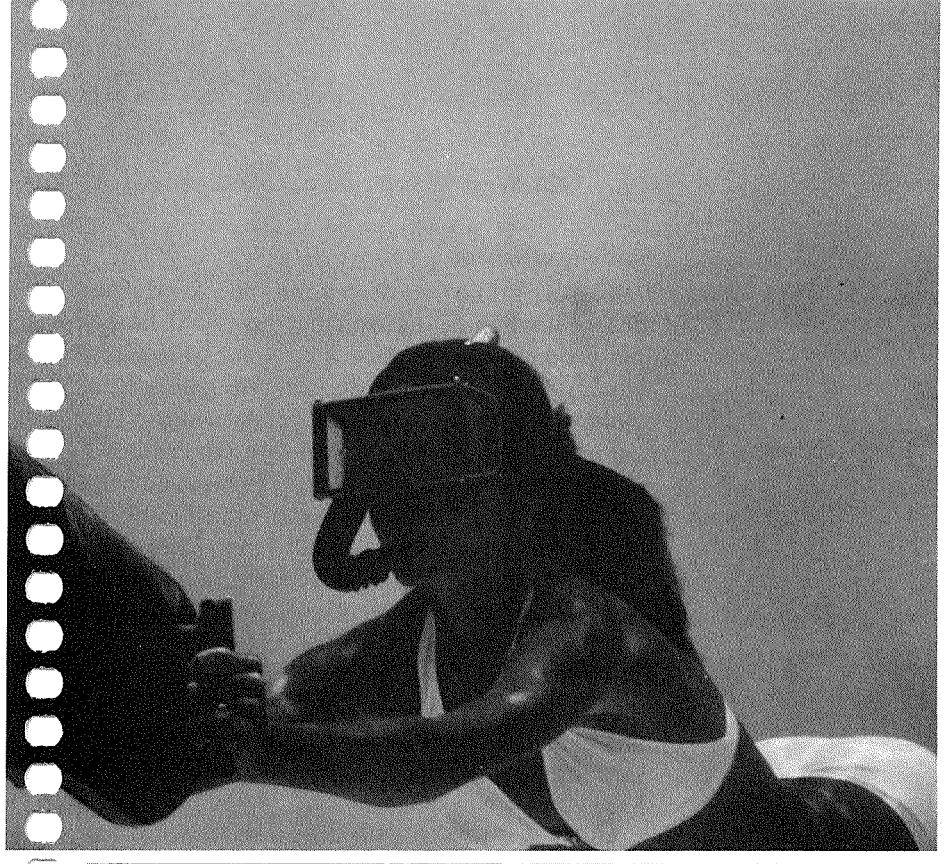


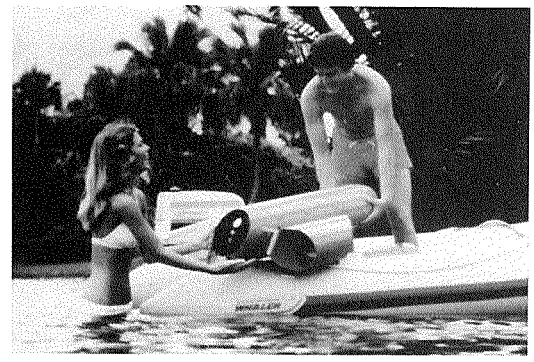
DUAL-BEAM dive light pinpoints objects and illuminates broad foreground area at the same time. It may help eliminate claustrophobic "tunnel" effect of narrow beams. Called Captain Nemo, it boasts 300,000-candle-power brightness.

DIVE KNIVES, like these from Wenoka, sport brightly colored handles for added eye appeal as well as easier spotting if dropped. Blunt-tipped style makes rugged prying tool. Pointed type is a small survival knife.

■ EXCITING THINGS are happening in the underwater world of diving gear. From the simple masks and snorkels of not too long ago we've come to such exotic equipment as wrist-worn dive computers that do practically everything for you but breathe.

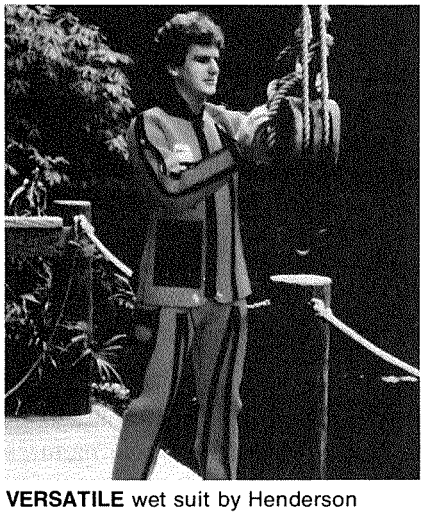
New equipment is highly sophisticated. You can't forget to time your dives with an ingenious self-operating underwater stopwatch called Bottom Timer. Unlike the usual dive watch, it has no outer timing ring you must remember to preset. Activated by water pressure, it automatically starts ticking as soon as you descend about six feet, and indicates elapsed time in both minutes and seconds up to one hour. As you surface, it stops. Because it records only actual bottom time, it keeps a running total of repetitive dive times. It has luminous, easy-to-read numerals and hands, comes in three dial-face colors—orange, blue and black—and sells for under $60



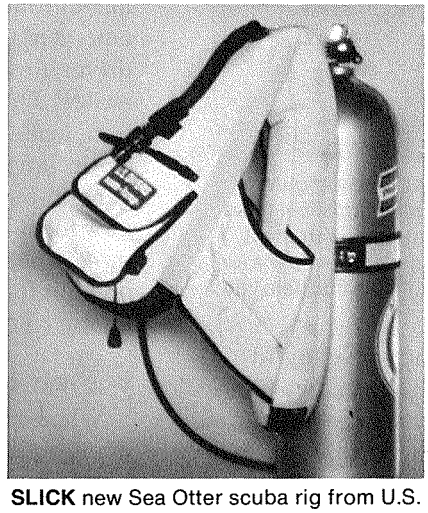


COMPACT, easy-to-handle Scuba-Tow II is readily lifted in and out of boat. In water, scooter is buoyant, will surface if let go.

SLIP YOUR camera into a plastic pouch like this and you can shoot pictures under water. The new soft enclosures from Ewa cost less than rigid housings, fold flat for easy carrying and storing, have optical-glass lens and viewfinder ports. A molded-in "glove" lets you operate camera controls from outside. In assorted styles and sizes for SLR and movie cameras, they're about $55 to $100 from Pioneer and Co.



VERSATILE wet suit by Henderson doubles as casual wear. Zippered folds in legs, arms and jacket open for comfort when worn topside. For diving, suit zips snugly, gives flotation, warmth.



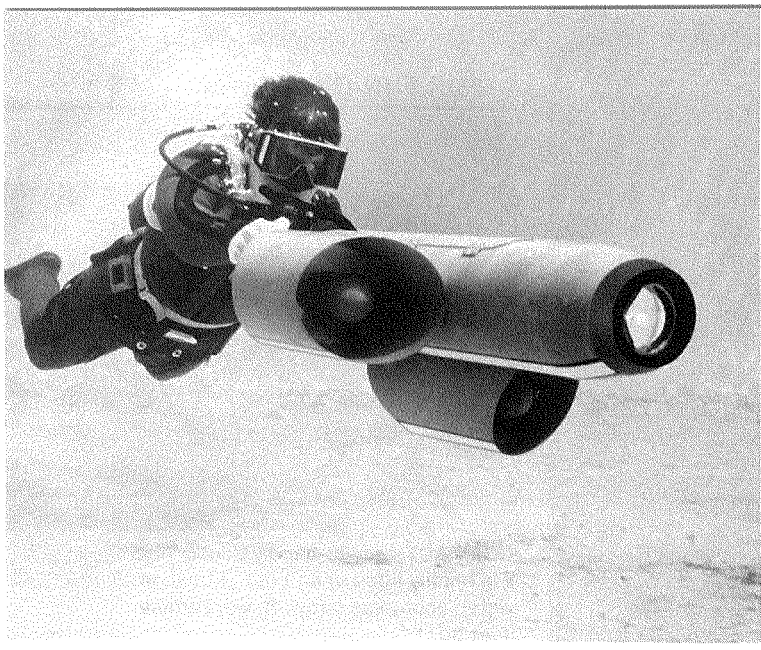
SLICK new Sea Otter scuba rig from U.S. Divers combines air-tank and buoyancy compensator vest in a single harness. One-hand controls allow easy adjustment of buoyancy.

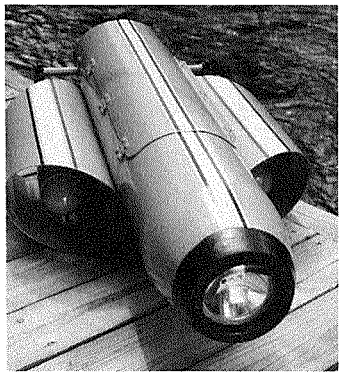
from Princeton Tectonics, Box 764, Hightstown, NJ 08520.

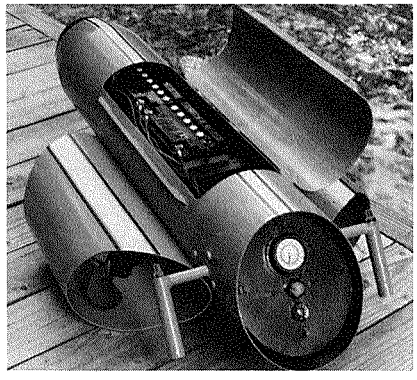
For the ultimate in sophisticated scuba instrumentation there's Dacor's diving computer, small enough to strap on your wrist. Programmed to operate on official U.S. Navy Decompression Tables, it takes most of the thinking—and danger—out of complicated diving situations. Bright digital readouts show depth, bottom time, surface time, repetitive dive times and both the depth and duration of required decompression stops. Warning lights indicate the need for decompression and signal an unsafe ascent rate. Price is about $425 from Dacor Corp., 161 Northfield Rd., Northfield, IL 60093.

clever wet suit, tank pack

Two slick ideas in increased diver convenience are Henderson's multi-purpose Zip-On Exposure Suit and U.S. Divers' Sea Otter air-tank backpack. The Henderson Zip-On is actually a wet suit that you can also use out of water, as foul-weather deck wear when boating in chilly or stormy seas. A clever system of zippered folds in the legs, arms and chest lets you expand the suit into a casual jacket-and-slacks affair for loose-fitting comfort topside. For diving, the







OUR OWN ELECTRIC diving scooter is easily guided through the water with bicycle-like hand grips. Features include headlight in nose (lower left) and instrument panel in stern (lower right). Hinged hatch cover opens for access to batteries, and to trim adjustments that help you execute intricate maneuvers.

folds zip tightly for a snug, body-hugging fit.

In an emergency, the suit also provides flotation and thermal protection. Tests show that, in 32° F. waters, it can extend the normal survival time of less than 10 minutes to as much as eight hours. The suit comes in bright orange or blue and is festooned with special pockets for a knife, tools, gauges and other diving gear. Matching boots, gloves and hood are available. It's about $262 from Henderson Aquatics Inc., Buck and Sassafras Sts., Millville, NJ 08332.

The Sea Otter B.C.V. is a nifty new two-in-one scuba rig that pairs an air-tank backpack with a buoyancy compensator vest in a single harness that makes it easy to put both on at the same time. There's only one strap to buckle and you're all set to dive. The three-way vest can be inflated from your tank, from an oral inflater tube or from an emergency CO_2 cartridge. Buoyancy is easily and precisely adjusted by one-hand inflation-deflation controls. For snorkeling, the tank pack can be removed and the vest used by itself. About $180 from U.S. Divers Co., 3323 West Warner Ave., Santa Ana, CA 92702.

knife overboard!

The next time you drop your knife overboard or lose it while diving, you may be able to find it more quickly. The latest dive knives are blossoming out with brightly colored handles to make them easier to spot underwater. The colors—high-visibility yellow and international orange—match other scuba accessories and help to add a bit of sparkle to a sport that, until recently, has been dominated by dismal black. We found the knives both attractive and sensible. They look particularly classy on a matching-color weight belt.

The knives shown here are from Wenoka Cutlery, 85 North Ave., Natick, MA 01760. Dacor and U.S. Divers are also offering knives in colors now, as are other makers. Prices run about $10 to $35.

Other features to look for in dive knives are line-cutting notches—especially valuable in an emergency—serrated edges for sawing, screwdriver tips and blades marked with measuring scales. The blunt-ended blade, a recent innovation, makes a sturdy prying tool with less chance of tip breakage. The traditional sharp-pointed, general-purpose survival knife is also out in a new form—a scaled-down mini version with a 4- or 4½-inch blade. It's small enough to be worn on your forearm or can be piggybacked on top of a larger knife, in a double sheath.

bag your camera

Whoever thought up the idea of putting a camera in a plastic bag to shoot underwater pictures hit on a good one. We tried it and it works. Imported from West Germany, Ewa's new soft-type enclosures are essentially plastic pouches sealed watertight at the top with screw-on metal clamps. They're not only cheaper than rigid underwater camera housings, but actually resist leaks somewhat better because of their collapsible design. The deeper you go, the more outside water pressure squeezes the plastic and inside air pressure keeps water out.

You can use the pouches down to about 30 feet—ample for the casual sport diver, especially since it's hard to shoot well-lighted underwater photos at much below 10 to 15 feet anyway. The bags will remain watertight at much greater depths, but the plastic becomes too stiff and compressed for easy handling. You work the camera's controls through an ingenious "glove" molded into the side of the enclosure. Optical-

glass ports for the lens and finder assure a clear field of view.

The Ewa housings are available in the United States from Pioneer & Co., 900 Haddon Ave., Collingswood, NJ 08108. There are styles for both SLR and movie cameras and sizes to hold such accessories as flash and motor drives. Prices range from about $55 to $100.

double-beamed light

We also liked the new Captain Nemo diving light from Underwater Specialty Co., 55 Bartlett Place, Brooklyn, NY 11229. Its brilliant quartz halogen lamp and specially designed reflector provide a dual-beam effect—an intense narrow beam for deep penetration, plus a broad peripheral beam for general illumination. You thus can pinpoint distant objects, while seeing what's around you at the same time—which makes for a warm, welcome feeling when you're exploring dark waters. Delivering 300,000 candlepower, the light is two to three times more powerful than most comparable models. At about $250, it's not cheap, but it's an impressive development.

PM's underwater scooter

Also appearing on these pages is *Popular Mechanics'* own Scuba-Tow II, a self-propelled, electric-powered diving scooter that whisks you effortlessly through the water for hours of undersea exploration or lazy surface snorkeling. You just hang on and let it pull you wherever you want to go. You steer with two handles that work like bicycle handlebars.

Commercial underwater scooters sell for $800 to $1200 or more, but you can build this homemade model from PM plans for under $300—and have it ready to go in a weekend or two of work.

Its smartly styled, tubular shape is easy to produce, because it consists of three sections of stock 8-inch-diameter aluminum irrigation pipe, readily cut with a sabre saw. The circular pipe is stronger than wood, resists underwater pressures better and eliminates the need for fabricating a built-up shape. A bright, sealed-beam headlight in the nose provides underwater illumination, as well as adding a sporty touch. A sloping panel at the stern mounts a depth gauge, compass, thermometer and other diving instruments.

easy to build and use

Like PM's earlier model, Scuba-Tow II was designed by Kent Markham, a marine construction expert and teacher.

The scooter is powered by two small electric fishing motors that develop a combined thrust of 40 pounds, or a little under 1 hp. This is enough to pull you along at about 3 mph—a brisk walking pace. Under water, that's a good clip. The motors are easy to mount because their housings are conveniently threaded to accept standard ¾-inch plumbing pipe. An ordinary pipe flange and short pipe nipple are all you need to attach each motor to the side of the scooter hull. Sections of aluminum tubing safely shroud the prop blades and give the craft the rakish look of a miniature rocket ship. Overall length is 42 inches, with a span of 22 inches across the motor shrouds.

parts readily available

By special arrangement with the manufacturer of the motors, PM readers are able to buy just the power heads, without tiller shafts and other hardware, thus saving money. The cost of both units together comes to about $160. Electricity is supplied by two small, 12-volt motorcycle batteries, readily available from Sears and other sources for around $30 each (the prices quoted here applied at the time this article was written). The 8-inch aluminum pipe used to form the hull and motor shrouds can be ordered by mail if it is hard to find locally.

While the scooter is especially effective when used with scuba gear, you actually don't have to be an accomplished scuba diver to have fun with it—that's one of its big advantages.

scooter won't sink

The scooter is designed to have slight positive buoyancy, so it will float when not in use or rise to the surface if you let go of it, with no danger of sinking. Its trim can be easily adjusted by sliding the batteries forward or back to shift weight toward the nose or stern. For diving, a little nose-heavy trim will help you guide the scooter downward. For surface snorkeling, it can be trimmed level or slightly nose-high to plane smoothly over the water.

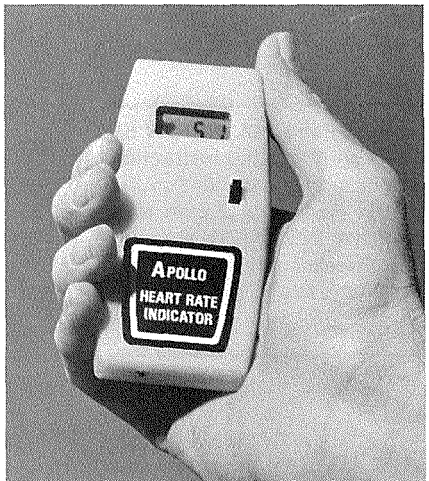
HOW TO ORDER PLANS FOR PM'S SCUBA-TOW II

For large, detailed plans plus an illustrated instruction manual send $8.95 in check or money order to Popular Mechanics, Dept. UW, Box 1014, Radio City Station, New York, NY 10019. Please make payable to Popular Mechanics. Allow three to four weeks for third-class mail delivery. For faster first-class mail, add 75 cents to your remittance.

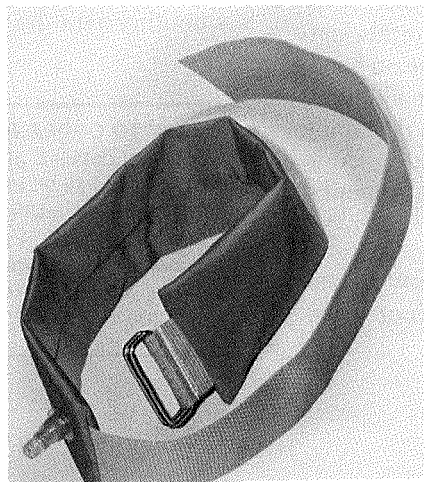
Gadgets and gear for exercise sports

SET a runner's speed with $25 Strider from Cronus Precision Products, 2895 Northwestern Pkwy, Santa Clara, CA 95051.

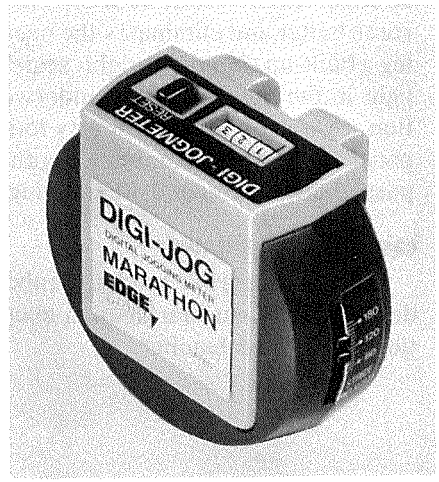
READ your pulse instantly on Heart Rate Indicator by Apollo Fitness Programs, West 10th Mission, Spokane, WA 99210.



WITH BUILT-IN bladder, $14 Bodabelt is from Bodabelt Products, 288 Douglas Ave., Boulder Creek, CA 95006.



SET for a runner's stride, Digi-Jog logs distance. Gutmann Co., 900 South Columbus Ave., Mount Vernon, NY 10550.



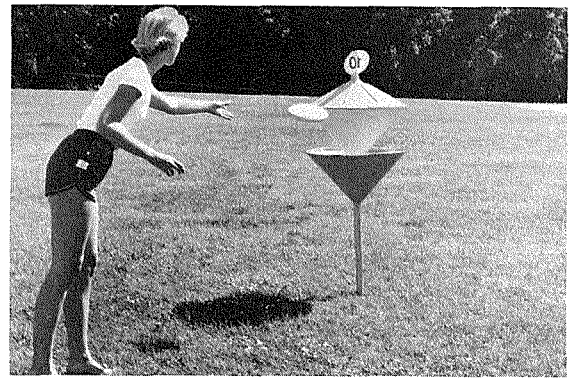
■ REMEMBER when all you needed for outdoor sports gear were old clothes and sneakers? Now, jogging has gone the way of skiing, boating, tennis and so many other sports for which complicated gear is a must. You need to impress your friends and improve your form with the latest in equipment.

Bodabelt Products has a money belt with built-in pint or quart-size bladders for your beverage. It's $14. The Digi-Jog clips on this busy belt, set for your length of stride, and reads off up to 99.9 miles. Joggeradio, from Jog-a-Lite, Silver Lake, NH 03875, $25, belt-mounts and plays through an earphone, or you can use the Cronus Strider, also $25, which, when adjusted for your stride and the speed you want, gives earplug beeps that pace you to a preselected time per mile. Ultimate for sound effects may be the $200 Aspen 360 from Cosmic Innovations, Box 10161, Aspen, Colo. 81611, a padded rechargeable stereo player with earphones that belts on runners, skiers, and hang gliders to pour out taped cassettes of instructions, encouragement or inspirational music to enjoy while exercising.

Joggers can select from enough wrist radios and pace-setter beepers to delight Dick Tracy. One radio, $17 from Radio Active, Box 233, Naperville, IL 60540, can fit in the back of a terrycloth headband.

A $190 wand, the Insta-Pulse from Sharper Image, San Francisco, CA 94101 is held in both hands to give a pulse-rate reading in LED digits. Only a finger is necessary to activate the Apollo $130 Heart Rate Indicator and tell when you are about to reach the 70 to 80 percent of your age-adjusted maximum that is considered most beneficial for a healthy workout.

Wrist and neck-strap watches are in profusion for jogging against a clock. Colorful shorts, T-shirts and sweat suits are now styled in any hue you can name. For inevitable strains and pains that are part of the sport, 3M has a new reusable Cold/Hot Pack to treat spots that hurt.



SAUCER GOLF, a way for Frisbees to go competitive in the back yard, is from Saucer Golf Inc., 3775 North Dunlap, St. Paul, MN 55101.

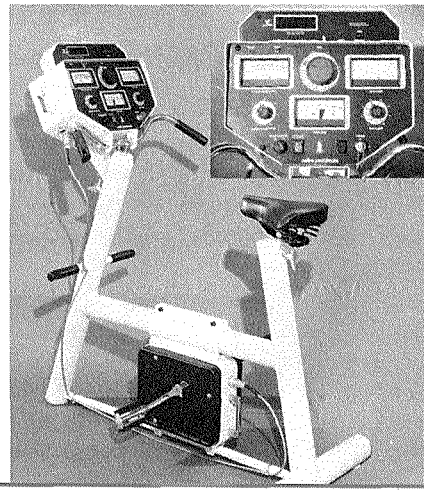
A lot of exercisers have decided they don't require the one-for-the-road race to stay in shape, and makers have been pouring out new games in agreement. Running in place is rated more fun on the Jog-N-Tramp, a mini-trampoline, $190 and only 8 inches high and 38 inches wide, that can be used both indoors and out to keep in shape.

Dozens of back-yard and lawn games are being introduced to use less expensive plastic equipment, and many are planned with practice elements for baseball, basketball, tennis, racketball and skiing for later in the season. Exercise bicycles can now measure energy expended, pulse and percentage of exertion level. You should, of course, receive a doctor's okay before you use one.

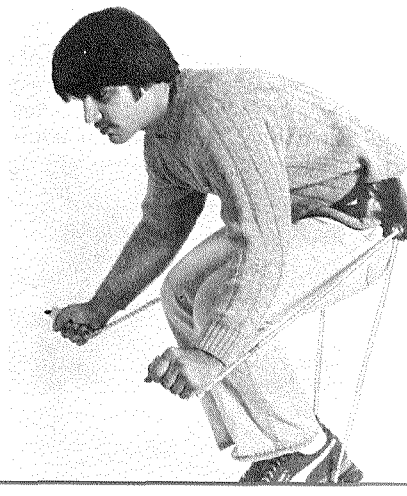
And don't overlook the new hammocks and lawn chairs; all hold you comfortably until the urge that compels you to exercise finally passes.

A RUNNING and catching game that takes little gear is Krazy Kones, $4.50 by Cosom, Box 1429, Minneapolis, MN 55401.

THE ULTIMATE sit-down stress test may be the $4000 Pedalmate Ergometer bike. Collins, 220 Wood Rd., Braintree, MA.



PRACTICE your downhill technique with Ski Shape, about $32. Major Sports Sales, Box 1385, Los Altos, CA 94022.



YOU CAN quick-change a standard Coleman 17-foot canoe into a white-water, two-man model with a new snap-on spray cover that will keep you, your partner and your gear drier in wild runs down the river.

Small boats: fun with less fuel

By BILL McKEOWN

■ BOAT OWNERS, and engineers, too, are seeking ways to get more performance from the little rigs.

We've learned how fast and far big motors and large hulls can go. The new challenge is to take a mini model and fit it out for the most action it can safely handle, while using the lightest power and least fuel—or none at all.

Paddle power uses no gasoline, and is suitable, as well, for certain waterways that do not allow boats with engines. Specially designed skiffs, canoes, kayaks and inflatables are now produced for running rapids and white water, but Coleman and Grumman also offer new cockpit covers to keep out water that might splash aboard.

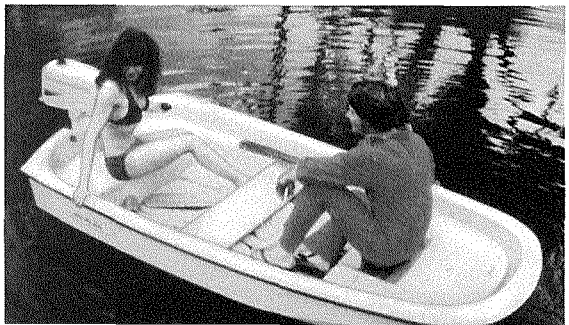
A cover will not make an average, all-purpose canoe design the equal of the no-keel fast-water models, but it can keep gear dry during long open water passages and helps when things get rough unexpectedly.

Most small skiffs, prams and dinghies can be rowed, but many were planned for outboard or sail, and are difficult to handle comfortably with oars. Fuel economy may bring back some of the fine old guide boats and rowing craft that seemed to glide along and were a delight to handle.

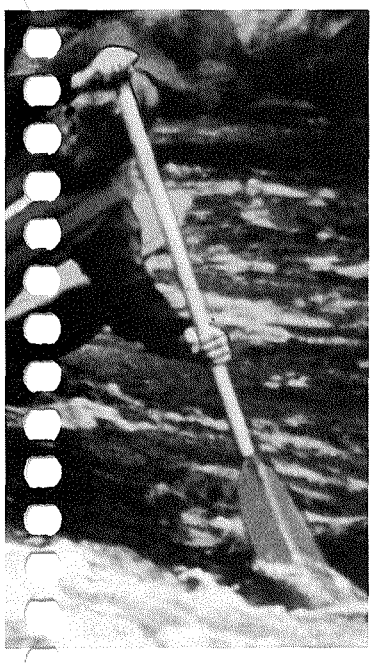
Meanwhile, small motors are packing more muscle. Outboards of 25 horsepower and less can push small craft up to 30 mph, and smaller mills will easily troll along all day on one self-contained tank of gas.

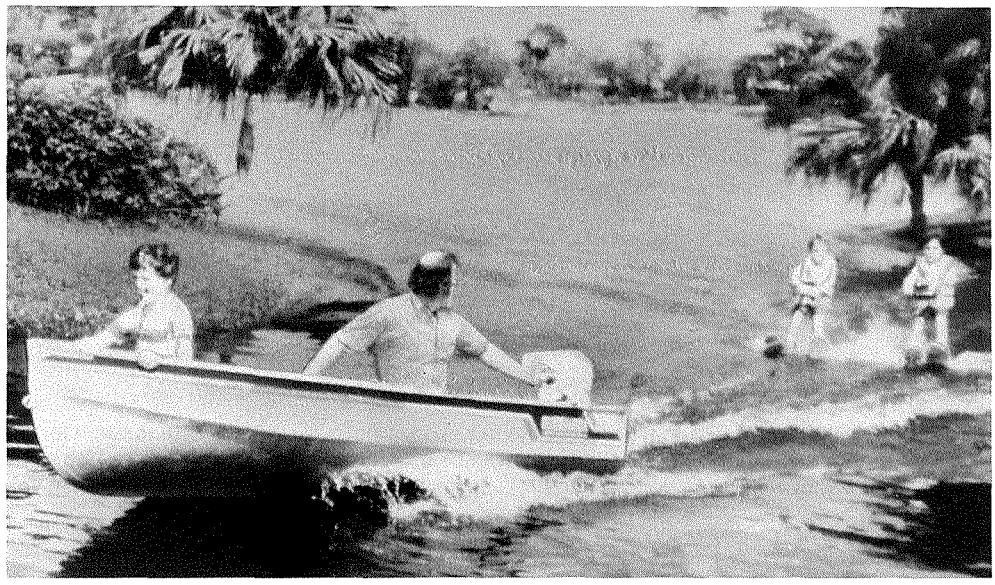
How much power is enough? Your hull should have a Boating Industry Assn. (BIA) capacity

BROAD BEAM and stable ride of wide multikeel designs like the Boston Whaler make a good fishing boat or a swimming raft. The 11½-foot hull, rated to 20 hp, easily handles a Johnson 4.5 hp motor.

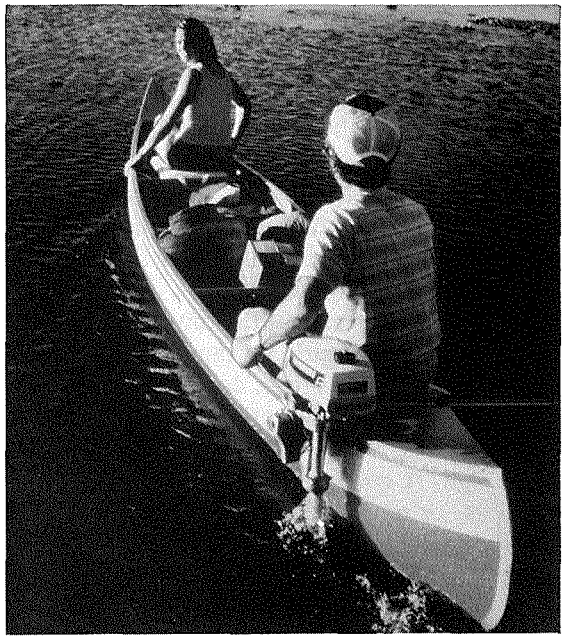


LIGHTWEIGHT HULLS need less power, are easier to cartop and launch. Grumman's 12½-foot aluminum 3.8 weighs 170 pounds, can do 22 mph and is rated for 10-hp motors like this Mercury 9.8.



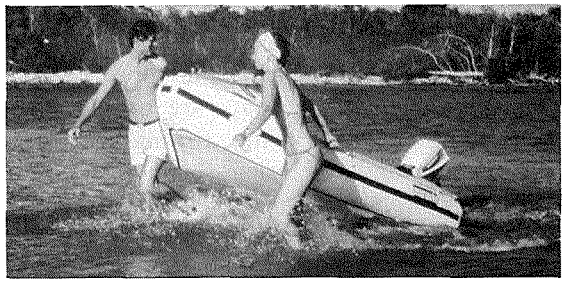


TWO SKIERS behind five hp? Ski instructor Jim McCormick tows talented sons Pat, 3, and Mike, 5, with a 106-pound Alumacraft 12-foot Cartopper, powered by Johnson's 4.5.



MINI-MOTORS that troll almost all day on a tank of fuel are ideal for canoes. Most canoe makers have a square stern model or this cross-thwart type.

SHOAL-DRAFT enough to explore the shallows, inflatables like the Maravia are made of rugged fabrics.



WETBIKE is a speedy machine. Beach Buddy accessory (left) roll-launches it.

Scooters that go afloat

With features of a motorcycle, a bareback bronco, a moped—and a firehose in the face if you fall off—the motorized water sled provides you with the sensations of water skiing without much of the work.

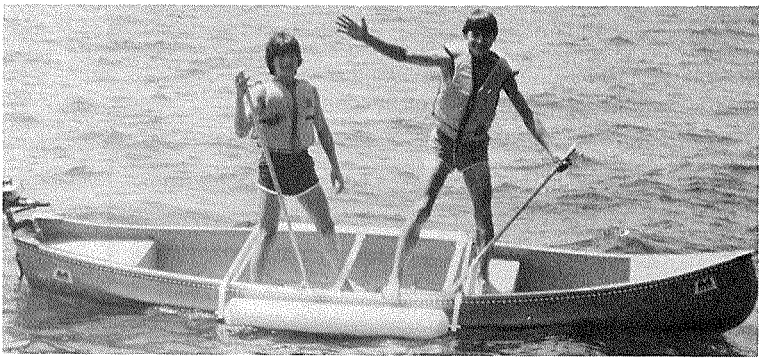
Two prominent models—the Wetbike from Arctic Enterprises, Thief River Falls, MN, and the Jet-Ski, Kawasaki Motors, Santa Ana, CA—offer speeds up to 30 miles an hour. Since they use water jet power, there is no danger from propeller blades. And if you should happen to take a spill, safety shutoff "kill" switches close the throttles.

Initially, the rigs were popular as a challenge over choppy water and through slalom courses. Now, an occasional owner will stow gear aboard and head off for an overnight beach campout. Competitions, with races and distance runs, have also been organized.

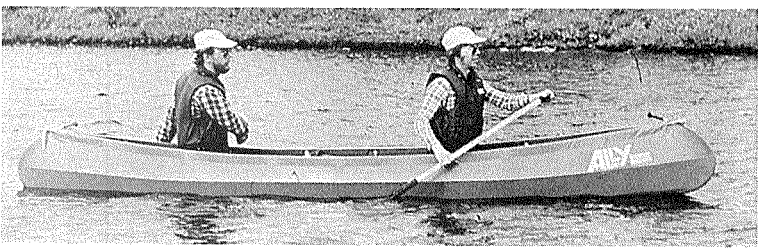
Various trailers and accessories are available. Prices for these machines begin at approximately $2500 so you may want to rent one and try it before buying.

BONAIR BOAT'S 16½-foot Brute 500 mounts up to 60 hp, has vee bottom for smoother ride, can even be ordered with diving window in bottom of hull.

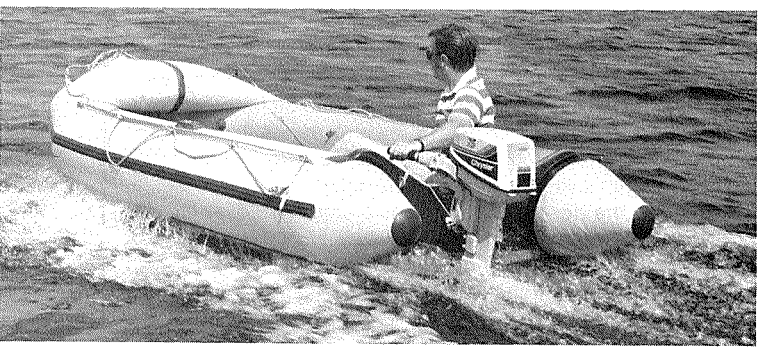
THIS 2-HP tow unit for swimmers and divers comes from Aqua-Scooter of Springfield, NJ. It also can serve as a small outboard when you are through diving.



TIPPY TENDENCIES of canoes like this stretch-formed Michi-Craft L-12 and other similar boats can easily be stabilized with pontoons.



CANOE you can fold into a 31-pound backpack unit, Ally Collapsible from Vogue Industries, LaSalle, Que., has aluminum ribs, PVC skin, and assembles in 20 minutes.



LOW CENTER of gravity for passengers and gear, plus independent flotation chambers in case of puncture, make inflatables like this extra safe.

plaque listing the top horsepower and weight of passengers and gear that it can handle. But less than maximum may still be plenty. The new Johnson 4.5, for example, when mounted on a small, light hull, can water ski two youngsters at once. Evinrude has a similar model. And since outboards under 10 hp can often be used where larger models are banned, all manufacturers have motors in this low fuel-consumption category. Craft that can fit on a cartop rack, inside a station wagon or on a small trailer all match up well with mini-motors.

Boats that may benefit the most from a trend to gas economy should be the already popular inflatables. Easy to store, convenient to carry, seaworthy and versatile, they offer bargains in watersport activities, though their prices will seem high. A quality blow-up boat will cost as much as, or more than, similar ones with rigid sides. Figure you'll pay over $1000 for a 12-footer and up to $6000 for a 20. These prices take them out of the swimming pool-toy field, where they never belonged.

New nylon fabrics with PVC polymeric coatings and, in some cases, even kevlar filaments, are giving inflatables more puncture and abrasion resistance. Rugged rigidity and low centers of gravity are making the new models safe enough for larger outboards, yet strong enough to pull water skiers and handle offshore waters.

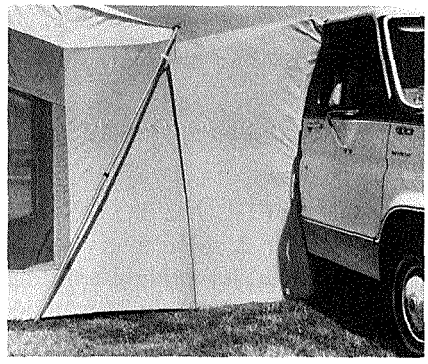
Small conventional boats are also making news these days. Cruising, fishing, camping, day boating and exploring sheltered shallow backwaters that the big boats never reach—these are just a few of the pleasures awaiting small-craft boatmen.

New for sportsmen

WINTER HIKES, both uphill and down, are easier on snowshoes. New models come in kits, assorted sizes, with cleated bindings from Sherpa in Chicago.

NEW FUEL for the old argument over outboard and inboard engines has shown up recently. Evinrude Motors bought a 28-foot Bertram Sports Convertible model without the two standard inboard engines usually installed. Cutting down the transom, they then mounted a pair of 200-hp V6 Evinrude outboards to take the place of two 233-hp inboards, and made a series of tests to see how the well-performing hull would run with two-cycle power.

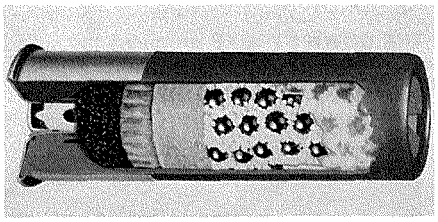
At slow displacement speeds, the inboards were as much as 34 percent more efficient in miles per gallon. Up on plane, the 400 horses of two-cycle power beat out the 466-hp inboard figures by a 21-percent savings at 25 mph, and an 83-percent gain in miles per gallon at the inboards' top speed of 34 mph. Then the two outboards added 14 mph for a top speed of 48.2 mph, amazing even the Evinrude engineers. Range of the boat could be increased from the inboards' 200 miles to 300 with the outboards, or to 500 miles with tanks installed where the inner engines had been.



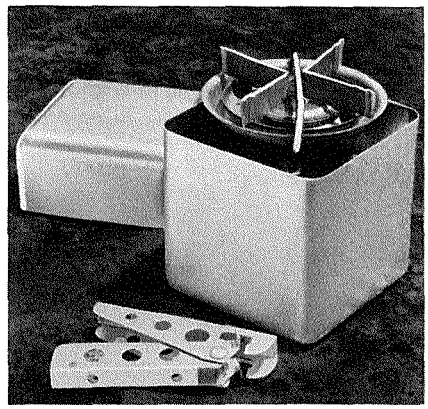
THE POPULARITY of vans has resulted in a number of new products. One of the most interesting joins a van to Coleman's largest tent, the Villa del Mar. The conversion kit attaches to the tent and then fits up tight to the van with sewn-in magnets for an extra-large living space.

OUTDOORS IT can get cold any time of year. A fall overboard during the winter can be lethal, and new exposure and survival suits are particularly welcome when hypothermia is a threat on the water even ashore. Several excellent suits and jacket-pants combinations are available. Imperial, in Bremerton, WA; Bayley, of Fortuna, CA; and Sterns, in St. Cloud, MN; are among sources. The U-Vic Thermoflat jacket, based on hypothermia research by the University of Victoria, is from Mustang Sportswear, Vancouver, B.C. It sells for over $250 and should be appealing to commercial fishermen and sailors, but could save anyone's life.

HERE'S A bivouac sack with space to spare for a single sleeping bag, and big enough for two. The R.E.I. Co-op's Bivi Sack can substitute for tent.



AMONG IMPROVEMENTS in shooting equipment are new shotgun shells recently introduced by Winchester-Western. Gently packed in granulated polyethylene inside a plastic collar, the shot pellets hold their shape inside the Super Double-X nonmagnum game load in 12- and 20-gauge. Filler helps each pellet retain its spherical shape. Denser patterns should result.



COMPACT little backpack stove from Peak 1 can be carried in its aluminum container/cook kit. Utensils are lifted with the pot gripper.

Newfangled muscle-powered wood splitters

By JOSEPH R. PROVEY

■ NEEDING TO SPLIT some wood this winter, I decided to try some of the new devices which make hand splitting easier. My experiences may help you choose the device that's right for you.

I first tried the Woodchomper, offered by Watson Mfg. Co. Inc. It's essentially a heavy metal sleeve on a steel pole, which has a wedge welded to one end. It's like a man-powered pile driver (the heavy-duty version, in fact, can drive steel fence posts) and has split just about everything I've tried it on.

It even split some large 18-inch-dia. black birch sections, but required up to two or three dozen strokes. On most pieces, 12 inches in diameter and less, a few strokes did the job. Advantages include accurate wedge placement, a no-strain motion, and easy portability. You can split large pieces at the site, making them easier to haul away. The Woodchomper is $49.50 postpaid. (All prices mentioned were current at the time this was written.)

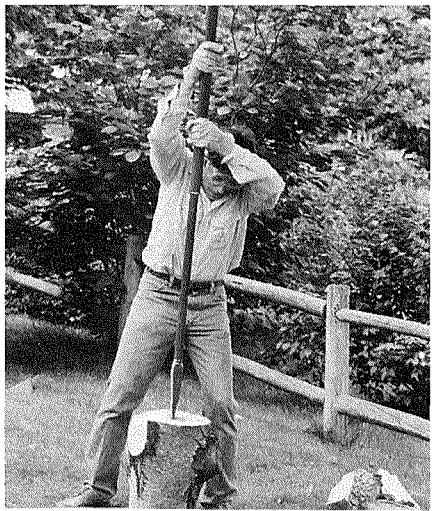
The main disadvantages are noise and armshock. *As with all splitters which involve banging metal against metal, ear plugs and eye protection are musts.* Steel-toed boots and work gloves also make for fewer injuries.

EACH OF THESE splitters has its good—and bad—points. Most of them can save you work, but you have to choose the one that best suits your build and temperament.

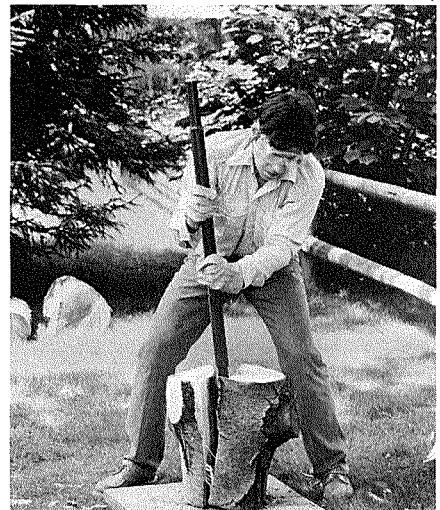
A truly muscle-powered splitter called the Baby Monster Maul comes from Sotz Corp. for $22.89 postpaid. Its predecessor, called the Monster Maul, weighed in at 20 pounds, but is being phased out in favor of a lighter version. The newer 12-pound model proved very effective once I became familiar with it. A few whacks split most pieces up to 14 inches in diameter. I particularly liked the steel handle, since it won't break. This was the quietest unit I tried.

Next I tried several guided-wedge type units. Two are pictured here, the Jiffy Woodsplitter ($99.95 postpaid) from C & D Distributors and

TO OPERATE Woodchomper, first slide metal sleeve to top of the pole. Vertical motion is easy on the back.



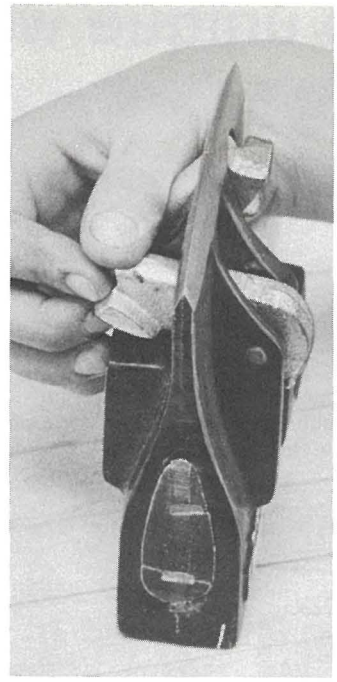
THE DOWN STROKE produces the split, as the sleeve hits the wedge welded on the pole's end. It may take several hits.

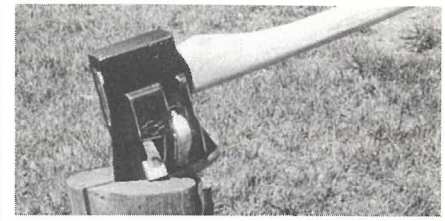


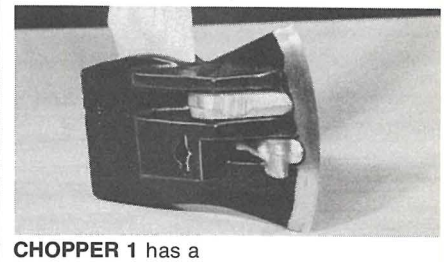
JIFFY SPLITTER has detachable base which bolts to post for easy carrying. Handle on wedge is a nice feature.

the Fast Woodsplitter ($59.95 postpaid) from Daka Corp. A third unit, called the Hammer Splitter I (not shown), retails at hardware stores for $42.57 and is made by Special Products Co. All units handled logs up to 24 inches long adequately. Their basic plus is that the wedge stays in one place, making it easier to hit with accuracy. The design of these units also makes it unlikely that you will hit the wedge with the neck of your maul or sledge hammer, causing the handle to fracture. Both the Jiffy and the Hammer Splitter have detachable bases, making them easier to store and transport. The Jiffy has a secondary wedge located beneath the convenient wedge handle, which helps prevent the primary wedge from getting hung up in large-diameter logs. It's also useful for splitting small pieces of wood into kindling. The Jiffy generally performed better than other similar units, but it also cost more.

The sixth hand splitter—Chopper 1—was given a workout by a friend. He reported that it's a fantastic tool which works best on 8- to 12-inch-dia., 20-inch-long logs. (See photos for how it works.) This fall a new version with an indestructible handle will be introduced. A fiberglass shaft makes up the handle core and is covered by a polypropylene molding which dampens vibrations and doesn't splinter. Price from Chopper Industries is $39.95 postpaid.







CHOPPER 1 has a spring-loaded lever on each side of a cast tool-steel head (left and above). As blade is driven into wood, levers grab at the edges to help split the log and prevent sticking.

The last device tested, called the Wood Grenade, retails for about $13.50 at hardware and discount outlets. It is simply a conically-shaped wedge made of hardened steel. It worked fine on small-diameter stuff, but was no match for larger pieces of hardwood. The cone shape disperses the sledge hammer blows in many directions, instead of in just two directions, typical of a conventional wedge. As a result, the Grenade tended to stall in the wood after being driven a few inches. Engineers who developed the device are working on an improved, longer version.

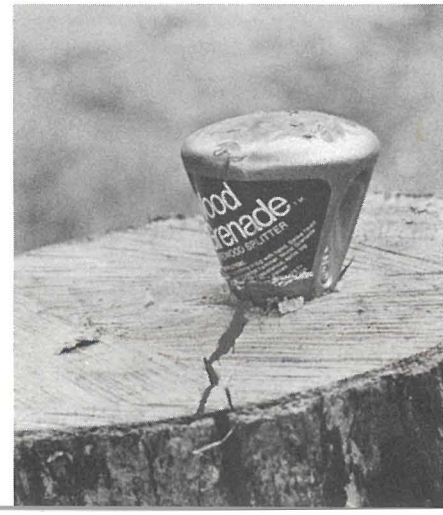
MANUFACTURERS LIST

C & D Distributors Inc., Box 766, Old Saybrook, Conn. 06475 (Jiffy Woodsplitter).
Chopper Industries, Box 87, Easton, Pa. 18042 (Chopper 1).
Daka Corp., Industrial Park, Pine City, Minn. 55063 (Fast Woodsplitter).
Omark Industries Inc., Consumer Products Group, 9701 S.E. McLoughlin, Portland, Ore. 97222 (Wood Grenade).
Sotz Corp., 13676 North Station Rd., Columbia Station, Ohio 44028 (Baby Monster Maul).
Special Products, 15000 West 44th Ave., Golden, Colo. 80401 (heavy-duty Hammer Splitter II, $61.59).
Watson Mfg. Co. Inc., Box 861, Brownsville, Tenn. 38012 (heavy-duty Woodchomper weighs 36 lbs., costs $74.50 postpaid. Plans for either unit are $3; specify size).

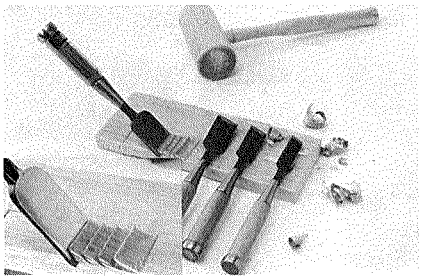
GUIDED WEDGE makes it easier to deliver accurate blows. The Jiffy unit can accommodate logs up to 2 feet long.

HEFTY 12-lb. Baby Monster Maul has an unbreakable steel handle. A few swings will split most 10-in.-dia. x 24 in. logs.

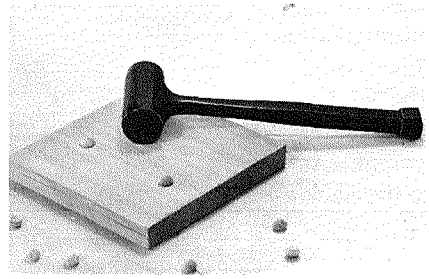
WOOD GRENADE had some difficulty in 12-in.-dia. black birch. An improved model, not available for tests.



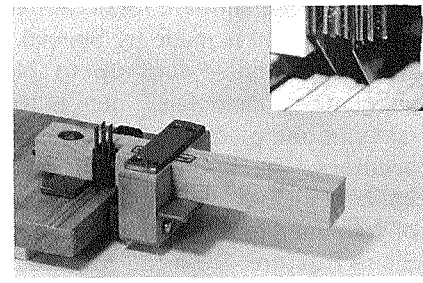
A dozen unique woodworking tools



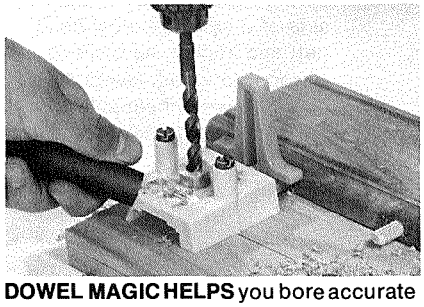
JAPANESE carpenter's chisels by Ooichi are made of hard and soft steels hand-forged together. Soft-steel keeps cutting edge from breaking. From Woodline, 1004 Central Ave., Alameda, CA 94501.



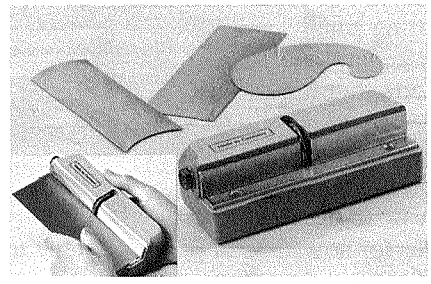
AS YOU SWING this hammer, lead shot in its head moves forward to produce a no-bounce blow. Outer plastic won't mar wood. From Leichtung Inc., 701 Beta Dr. No. 17, Cleveland, OH 44143.



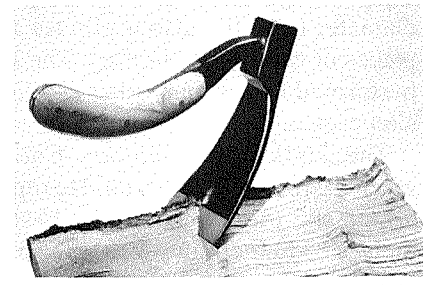
CUT STRAIGHT, circular and odd-shaped veneer veins with this inlay cutter. With two blades, clearing cutter and guide from Albert Constantine and Son, Inc., 2050 Eastchester, Bronx, NY 10461.



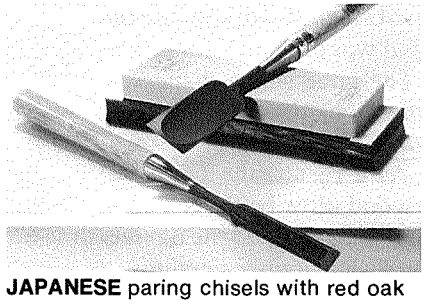
DOWEL MAGIC HELPS you bore accurate mating holes. Kit includes jig, guide, drill with depth stop and fluted dowel pins from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN 55374.



PUT A PRECISION edge on a cabinet scraper with this burnisher by Ulmia. Its steel-sharpening wheel is easy to use and consistent. It's from Fair Price Tool Co., Box 627, La Canada, CA 91011.

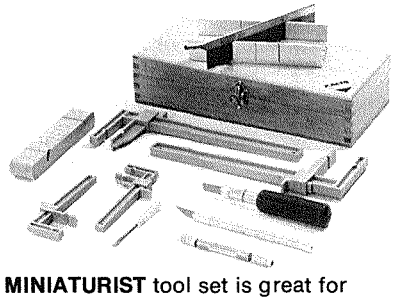


HOLLOWING ADZ has a forged head that is tapered from the edge to prevent binding in the work, and a solid forged handle. From Woodcraft Supply Corp., 313 Montrose, Woburn, MA 01801.



JAPANESE paring chisels with red oak handles are for delicate cuts. Blade widths range from 3 mm to 36 mm. For information: Woodline, 1004 Central Ave., Alameda, CA 94501.

POSITION this punch over damaged veneer, give its handle a sharp rap and then cut replacement patch the same way. In six sizes from The Woodworkers' Store, 21801 Industrial Blvd., Rogers, MN.

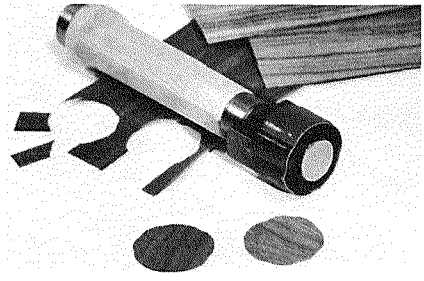


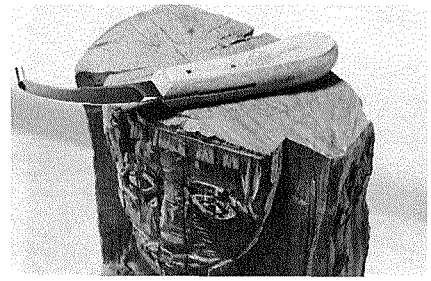
MINIATURIST tool set is great for constructing miniatures and other detail work. It includes a variety of small clamps and tools. It's from Craftsman, 2727 S. Mary, Chicago, IL 60608.

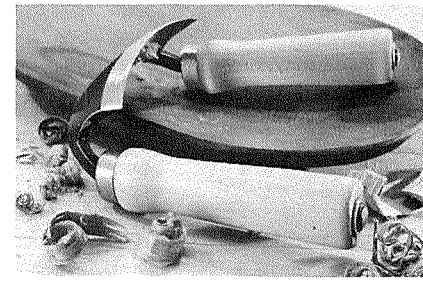
DESIGNED FOR RAPID roughing out, carver's hook knife cuts on both pull and push stroke in right or left-hand models. Available from Garrett Wade, 302 Fifth Ave., New York, NY 10001.

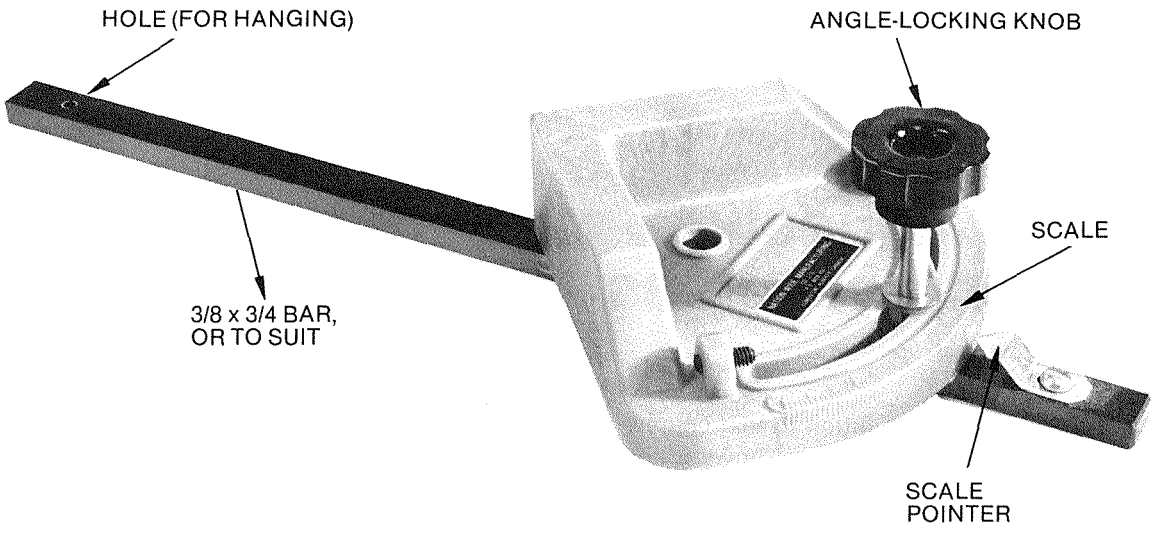
MAKE YOUR OWN threads in wood with a woodscrew box, and cut mating holes with a steel tap. Box and tap are available from Wood Carvers Supply Co., 3112 West 28th St., Minneapolis, MN 55416.

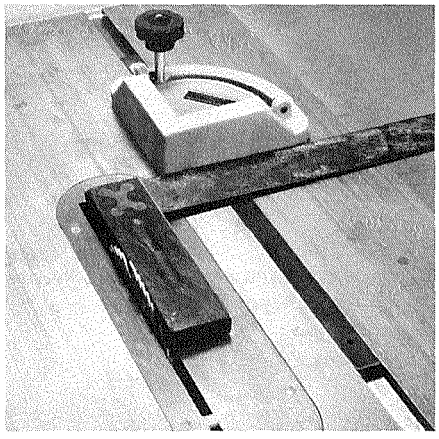
HOLD THIS woodworker's inshave in both hands and pull it toward you to hollow, scoop or scrape concave areas. From Brookstone Co., 493 Vose Farm Road, Peterborough, NH 03458.







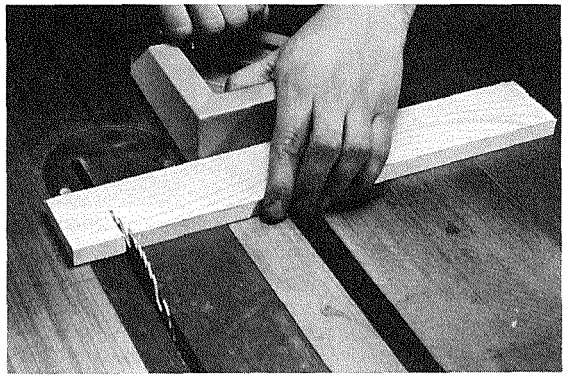




TOOL IS INSERTED in table's miter gauge groove and square is used to align one face at 90° to blade. Adjust the pointer, if necessary, and lock knob.

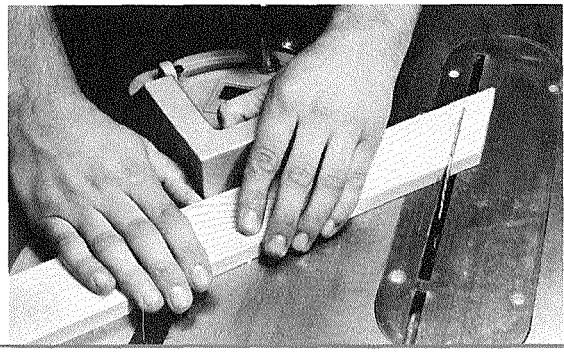
Cut perfect miters every time

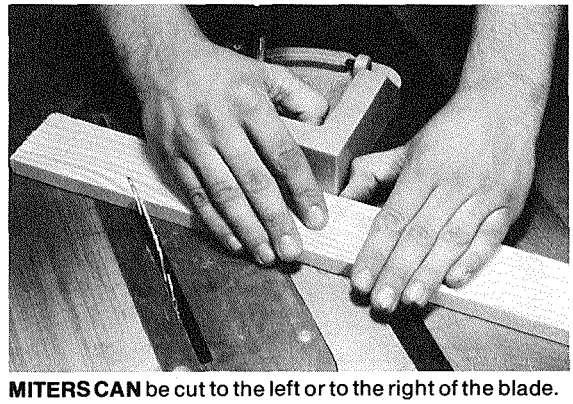
■ THE BIG ADVANTAGE that the Perfect Miter has over a conventional miter gauge is that mating miter cuts can be made with the same setting. To cut second miter, just switch tool to second groove, as in photos. The tool is especially handy for one-of-a-kind jobs, such as unusual angles. It is lightweight and easy to adjust and use. It comes with a bar sized to suit grooves in most table saws (⅜ in. deep by ¾ in. wide); if grooves on your saw vary, let manufacturer know exact size desired and bar will be custom machined. Perfect Miter is about $33 postpaid from Nationwide Manufacturing Co. Ltd., Box 457, Edmonton, Alta., Canada T5J 2K1.



TO MAKE a crosscut, hold the work and miter device as shown and use a slow feed for perfect 90° cut.

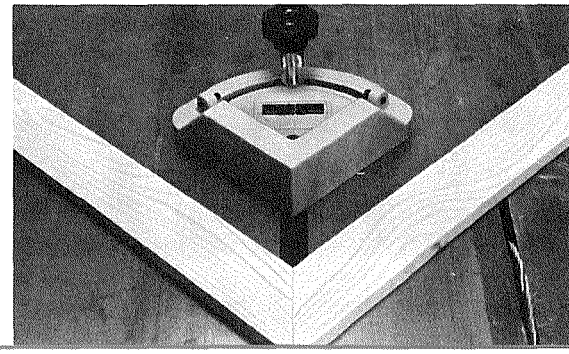
TO CUT mating miter, put the device in the righthand groove of the saw table and change your hand grip.





MITERS CAN be cut to the left or to the right of the blade. Hold the setup as shown.

WHEN IT'S ADJUSTED and used properly, the miter tool cuts angles that will be on-target every time.



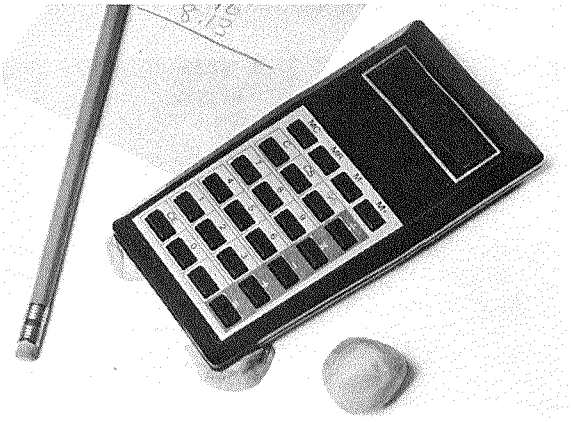
A new adhesive with endless uses

By DOUGLAS EISMAN

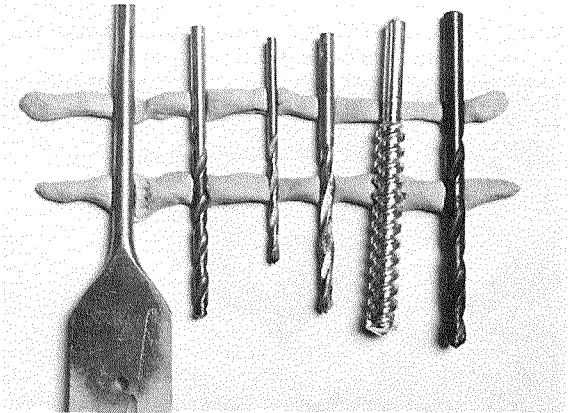
■ NOW THERE IS a solution to that common problem facing do-it-yourselfers: how to keep materials in position while working on them. Fun-tak, a putty-like, reusable adhesive from Permabond International Corp., holds the materials.

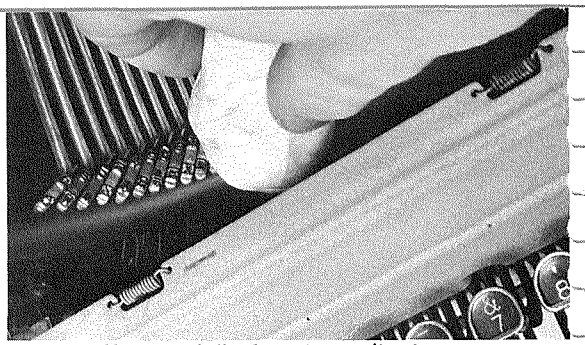
Fun-tak is nontoxic and doesn't stain objects. A pack of four 3½-in. strips costs about $1.70 in hardware and houseware stores. The adhesive has endless uses besides those shown. Use it to hang small tools and parts, blueprints and or other light objects on walls. The items can be taken down and replaced as often as needed without the adhesive losing holding power. You can also use it to anchor bottles that contain staining liquids, preventing accidental spills. Also, secure fragile items, such as china, to protect them and electrical wiring, to keep it out of sight. Pencils and erasers won't roll off tables if they're anchored in place.

STOP calculator travel while figuring your tax this year. Anchor the calculator in the adhesive.



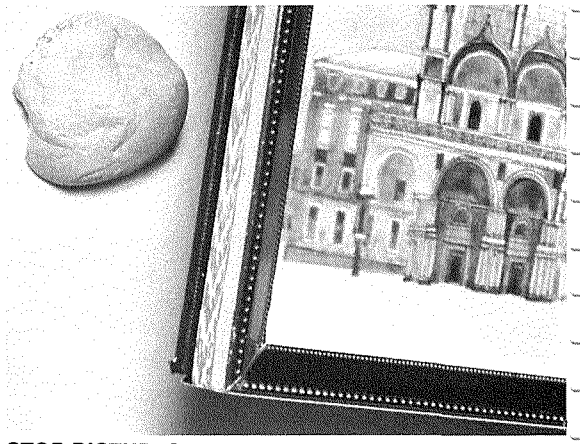
KEEPING DRILL BITS within reach is easy. Just use Fun-tak to hang them on a wall above your bench.





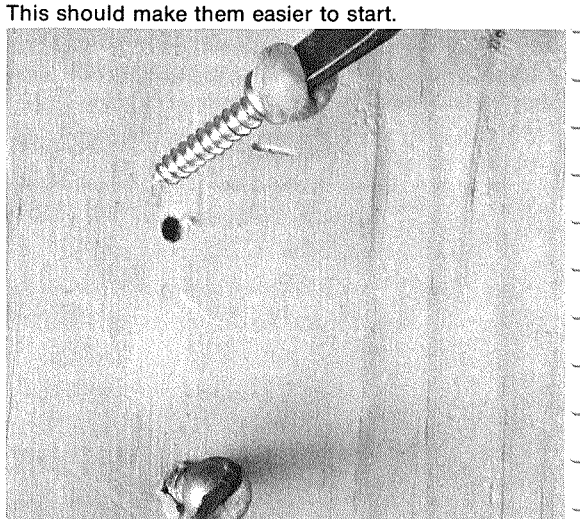
TO CLEAN ink and dirt from typewriter keys, press on Fun-tak and lift. The dirt comes off with the adhesive.

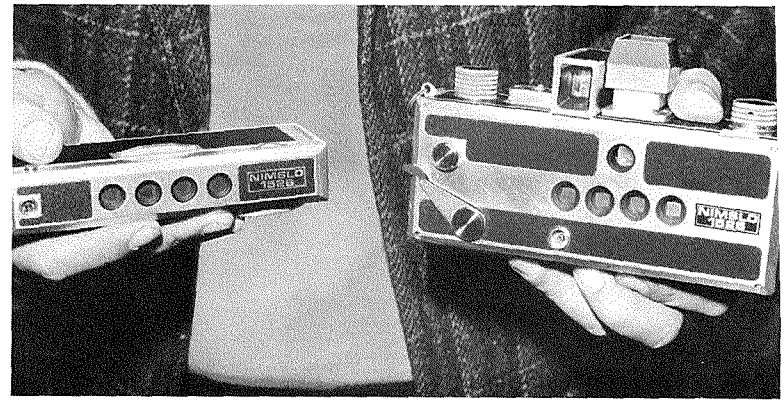
THROW RUGS can be anchored with a pinch of adhesive at each corner to prevent slipping.

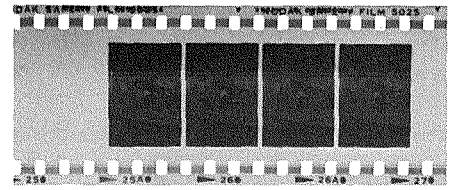


STOP PICTURES from tilting by using a flattened-out spot of the adhesive under one corner of the frame.

TRY using the stuff on the heads of small slotted screws. This should make them easier to start.







PROTOTYPES (top) for 110 (left) and 35-mm Nimslo cameras are similar to conventional units except for four-lens arrays. A 35-mm negative is shown above.

Here's a revolutionary 3-D camera

By TOM SAHAGIAN

■ THREE-DIMENSIONAL photography—long hindered by bulky, expensive cameras which produced mediocre results—will soon be as easy as conventional picture-taking, thanks to a system developed by two Atlanta entrepreneurs. Nine years in the making, the system can deliver 3-D prints in black-and-white or color that need no special viewing apparatus, at a cost slightly above that of conventional 2-D prints, according to its developers.

The two men, Jerry Nims and Allen Lo, have formed Nimslo Technology Inc., and are negotiating with a "major multinational firm" to manufacture their Nimslo 3-D camera. They make a lot of claims for their camera, their 3-D process and its final product, so I went to their factory to see how valid those claims are. I was not allowed to see any of the machinery that turns almost-ordinary negatives into 3-D pictures (for proprietary reasons, I was told), but I was able to use the Nimslo camera prototype.

One feature of the camera immediately sets it apart from all others: it sports not one, but four lenses, spaced about a half-inch apart. Previous prototypes had as many as seven. All four lenses have the same focal length, and axes that are parallel to one another. A special shutter opens all four apertures simultaneously.

The Nimslo camera uses standard 35-mm film, but instead of a full-frame negative, each shot exposes four that are each slightly less than half-frame size. Thus, a 36-exposure roll will yield 18 Nimslo pictures.

The film is developed in the usual way, then comes the proprietary processing. The printing material is coated with a thin layer of extruded plastic that forms a series of parallel lenses 1/200 inch wide. A Nimslo-designed machine enlarges and optically slices each of the four negative images into strips about 1/6400 inch wide. Eight images of each strip from each negative are printed next to one another in four groups under each lens. Thus, each group of eight times four strips is under one lens and the arrangement of the strips is such that, when you view a picture at normal viewing distances, you get a lifelike 3-D effect.

controlling depth of field

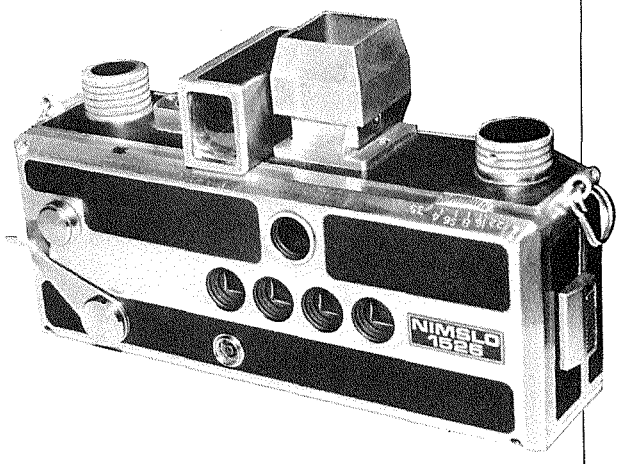
"What we're basically doing is closely reconstructing the visual and psychological information the eye sees when it looks at real objects," Nims says. Their biggest challenge, he says, was to find the formula for and then control the depth of field of the picture so that both foreground and background would be in focus. Right now Nimslo is unwilling to be too specific about how they accomplished this, but it is clear that they have.

Does the new system work? Yes, and well. I shot a roll of Plus-X black-and-white film with the Nimslo camera and tried to take as many different kinds of shots as I could. The 3-D effect was impressive, although somewhat eerie. I could push my finger "through" the parts of the picture that seemed to appear in front of the picture plane.

The photos also had good depth of field, good detail and sharpness, and generally compared favorably with conventional snapshots. Nimslo does not seem to have greatly sacrificed any important conventional qualities for the sake of 3-D. In fact, Nims claims his prints show less grain than 2-D prints.

The photos were not perfect, however. Unless a print is held steady, certain parts of the picture may seem to shift back and forth. And those portions that are out of focus are more annoying

PROTOTYPE for 35-mm camera lacks many of the niceties that later production models will have.



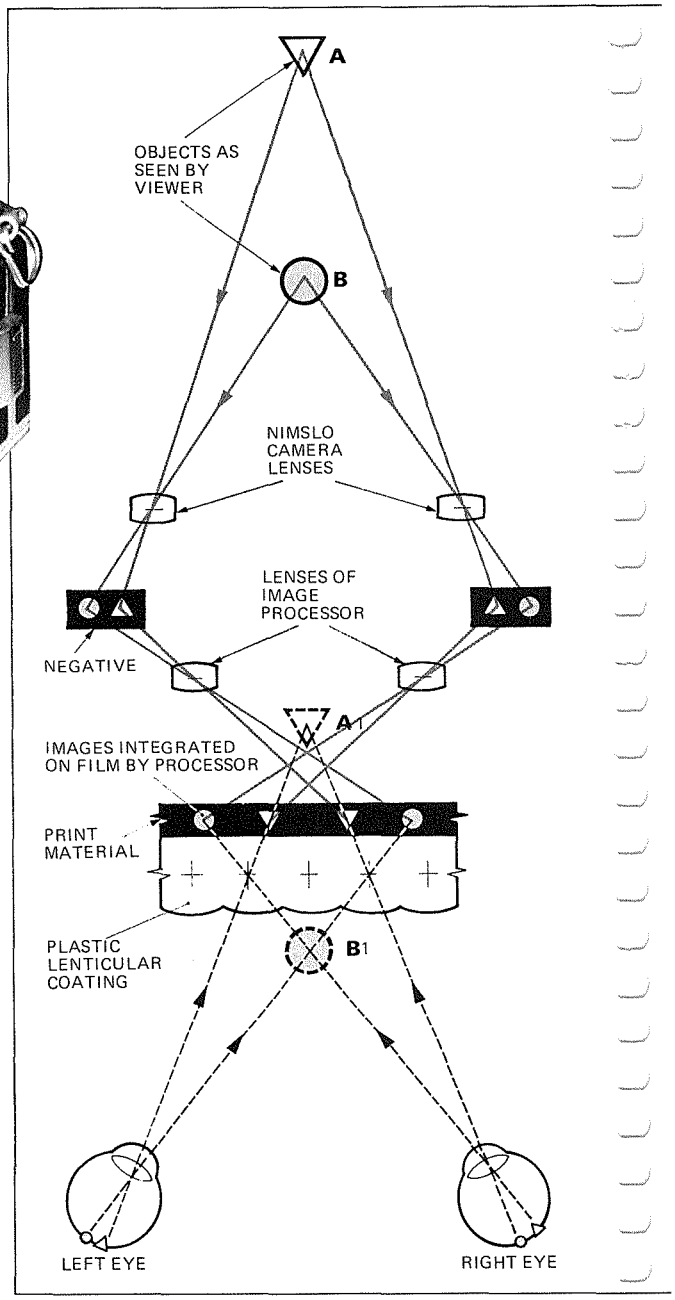
to the eye than they would be in a conventional photo.

The first Nimslo amateur camera, which will probably be marketed in Europe next year, will use 35-mm film and have a programmed-shutter for automatic exposure control and fixed-focus lenses. According to Nimslo, however, future cameras can have variable focus, variable aperture and even interchangeable lenses. In fact, any feature conventional cameras have can be put on the Nimslo, according to the company. "Technical barriers are not a problem," Lo says, "what we put on the cameras will be the result of a marketing decision." Similar logic would apply to the introduction of a 110 Nimslo camera.

The Nimslo process can handle both prints and transparencies. In fact, for the last three years, Nimslo has been test marketing a system closely related to their amatuer process, called Computrak, that makes 3-D pictures with any standard 35-mm camera. From 6 to 11 negatives are required for a given picture, however, so its applications are limited. But the principles that led to the development of Computrak comprised the breakthroughs needed to produce the Nimslo camera.

Nimslo's first venture into the 3-D market in the United States could be in the portrait field, where they will find a growing number of competitors. Nims claims they all use variants of the X-ograph or other older processes. Nimslo's portrait cameras are expected to be more like their 35-mm prototype than like the large, bulky units of the others. A competitor, Walker Color Inc., is said to be working on an amateur camera, as well.

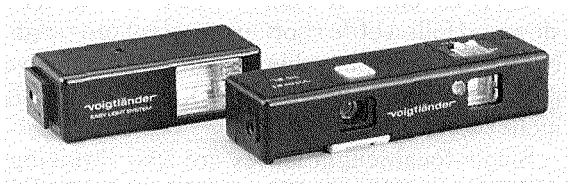
HOW THE SYSTEM WORKS

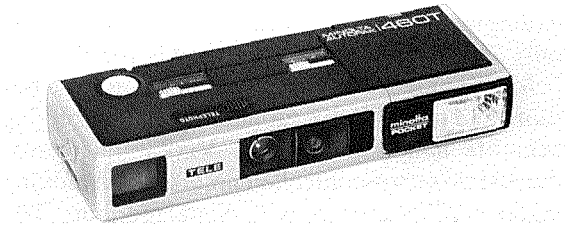


CAMERA: Lenses simultaneously make four negatives (only two lenses and negatives are shown for the sake of simplicity). **Processing:** The printing material is bonded to a thin layer of extruded plastic. The plastic forms a series of vertical lenses each about 1/200-inch wide and as long as the print. Each negative image is then enlarged and optically "sliced" into strips about 1/6400-inch wide. Eight images of each strip from each negative are projected onto the print material under corresponding plastic lenses. Thus 8 times 4, or 32, image slices are crammed under each lens. **Final Print:** The lenses on the print reflect the images of A and B underneath in such a way as to reconstruct the pattern of light rays reflected from the original objects. Images A1 and B1 appear to the eye to be behind and in front of the plane of print, respectively.

THE AGFAMATIC 901E 110 camera has a built-in motorized film advance. It can be used for single frames or set for continuous shooting.

SHOWN BELOW are: the Tiny Voigtlander Vitoret 110EL, which features a programmed shutter and add-on flash; the Minolta Autopak 460T, with built-in flash and slide-in telephoto lens; the Keystone Zoom 66, which sports a 25-42-mm zoom lens; and the vertical-format Hanimex VIF 110, which is designed to be held more securely to reduce the chance of camera shake.





Smaller cameras sport more features

By TOM SAHAGIAN

■ RECENTLY, MOST MAJOR single-lens-reflex manufacturers (including Nikon!) have come out with new compact, automatic cameras, all listing for about $400. But of wider interest are new products from the makers of 110 and 35-mm cameras. They're putting more features into their cameras and making them smaller. For example, the Minolta Autopak 460T ($117) includes built-in flash, slide-in telephoto lens, variable focusing and three-position exposure control. It measures less than 7×2½×1¼ inches.

Much smaller (and with fewer features) is the Voigtlander Vitoret 110EL ($66). At 4¾×⅝×1⅓ inches, it shouldn't be put in a pocket with a hole in it. It's a fixed-focus unit, with two aperture settings and a programmed shutter ranging from 1/300 to 4 seconds.

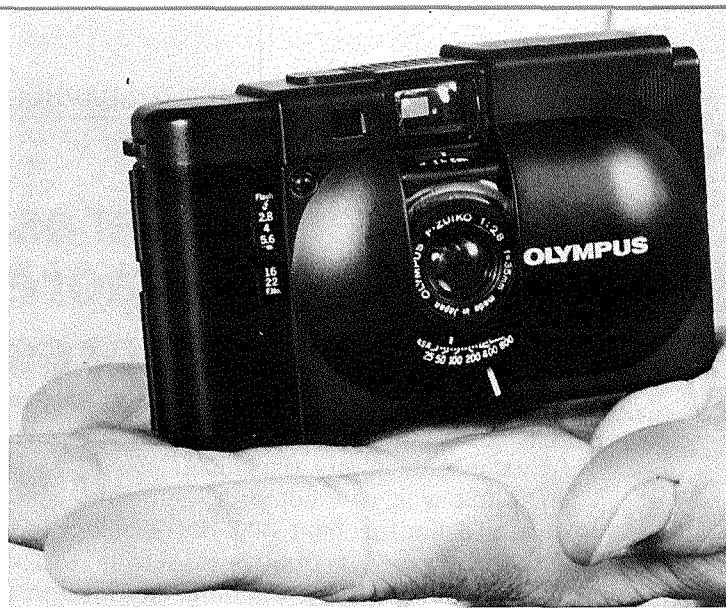
The Agfamatic 901E has one feature sure to appeal to the American market: built-in motorized film advance. It can be set for single-shot use or will keep shooting as long as you keep the shutter release depressed. It measures less than 5×2¼×1¼ inches and costs about $170. (Prices in this article are approximate, and were in effect when this article was written.)

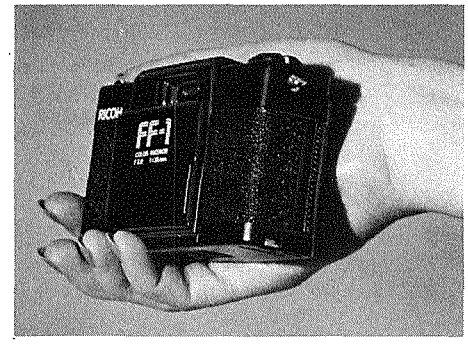
The Keystone 66S ($108 with flash), like the Minolta 110 Zoom and the Fujica 350 Zoom, has—what else?—a zoom lens. Zoom range is 25 to 42 mm, aperture range is f/5.6-f/16 and there are two shutter speeds. Size is 4⅞×2⅝×1½ inches, and flash is available.

Don't mistake the Hanimex VIF 110 ($60) for one of the 35-mm cameras it resembles. It's one of a growing number of vertical-format 110s designed to reduce camera shake. The vertical configuration is supposed to make it easier to hold the camera steady.

In 35s, the big news is the new super-small cameras from Ricoh and Olympus.

The Minox 35EL (succeeded now by the 35GL) is still the smallest full-frame 35-mm camera, but not by much. At 4.2×2.37×1.2 inches, the Ricoh FF-1 is only slightly bigger. Like the Minox, it has a fold-down front lens cover and retractable lens. It features a programmed automatic shutter (range 1/500 second to 2 seconds), 35-mm f/2.8 lens, single-stroke film advance and





THE RICOH FF-1 35-mm camera (left) folds flat for easy pocketability. The Olympus XA 35-mm (above) features a rangefinder for focusing. The cover slides shut to protect the lens and deactivate the metering system.

hot shoe. With the lens set in a special automatic mode, optimum aperture and shutter speed are automatically selected. The FF-1 lists for $255.

Not to be outdone, Olympus has introduced the XA, which is larger than the Ricoh (4.02×2.52×1.56 inches), but still fits in your hand. A sliding clamshell lens cover activates the metering system and protects all optics. Despite its size, the XA has one feature the other two don't—rangefinder focusing. You have to guess with the others (not difficult). The XA has aperture-preferred automation, a back-lighting compensator button, "feather touch" shutter release and a self-timer with both audio and visual indicators. Like the Ricoh, it has a 35-mm f/2.8 lens. An add-on flash is available. Camera is $200.

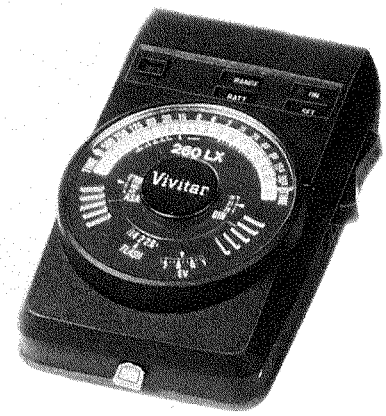
From Tokina comes a 28-85-mm f/4 zoom that comes teasingly close to being the much-awaited "universal lens." It's not, because it's still a bit slow and falls a little short in the telephoto range, but it's still quite an achievement. It's expensive ($595) and heavy (20½ ounces), but is only 3⅝ inches long.

Single-focal-length lenses are also shrinking, and the new Minolta 250-mm, f/5.6 is a perfect example. This catadioptric (mirror-type) lens is only $2^{5}/_{16}$ inches long. The price is $380.

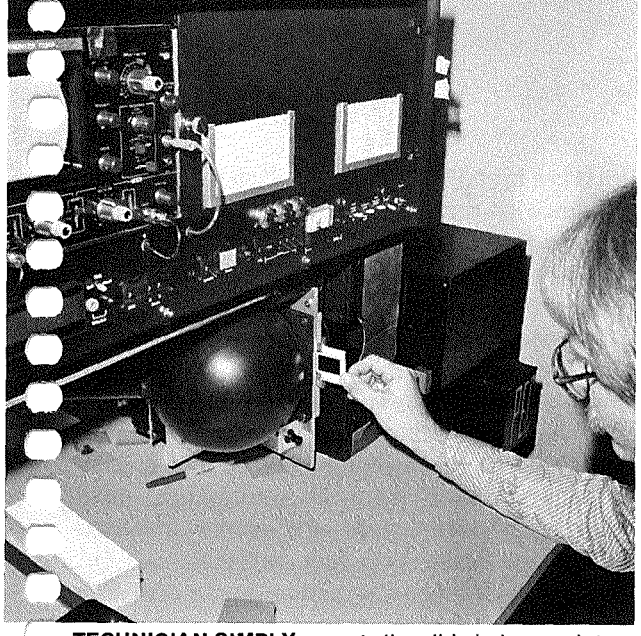
Most cameras have built-in light meters, but more and more photographers seem to be buying separate hand-held meters. Vivitar has introduced two servo-controlled units with no moving meter needles and two with digital readouts. The top-of-the-line 260LX and 230LX can be used both as light meters and as flash meters. They're $225 and $208, respectively.

WITH A wide zoom range, Tokina's 28-85-mm f/4 zoom comes close to being a universal lens.

THE MINOLTA 250-mm f/5.6 mirror telephoto lens is only $2^{5}/_{16}$ inches long. It's priced at $380.



A SERVO-CONTROLLED dial on the Vivitar 260 LX meter omits the moving needle.



TECHNICIAN SIMPLY mounts the slide in laser printer. Scanning process takes less than 20 seconds.

Lasers help make better color prints from slides

By TOM SAHAGIAN

The wave of the future might be this new machine that uses laser beams and electronics to do a job usually left to optics and filters

■ A LASER-BASED machine that helps make color prints from slides is the first step in what could be a revolution in photographic printing. Made by the Photo Electronics Corp. (PEC) of West Palm Beach, FL, it is said to make prints with the sharpness and color fidelity of the conventional method at much less cost.

Other means for making inexpensive prints from slides exist, so what's the big deal?

There are basically two types of color film (not counting instant): negative film for prints and reversal film for slides. Most amateur photographers use negative film; it can be processed quickly and cheaply and yields handy-sized prints. Most professionals use reversal film because they want to project their images, slides are cheaper than prints, or they prefer the color.

PEC believes that prior to its LaserColor process, there was no quick, cheap way to make good prints from slides. The traditional dye-transfer process is complex, time-consuming and expensive (an 8x10 print is $200 or more), but because it allows maximum control, results are superb.

Much less costly are C-prints, made by taking a picture of the slide on negative film (called an internegative) and printing from the negative. Results are generally good, but suffer because the prints are second generation. Very inexpensive prints made with a "throwaway" internegative are available, but quality is poor.

The other processes make prints directly from the slide. R-prints, using chemicals and paper from Kodak, cost about the same as C-prints, but the quality leaves something to be desired. The Cibachrome process, which has attracted many boosters in recent years, compares in cost with C-prints, is known for excellent longevity and has been used extensively for art reproduction. However, many people feel Cibachrome prints are too dark.

PEC says it can make prints with the fidelity and sharpness (but not necessarily the longevity) of dye transfers at the cost of C-prints.

The LaserColor printer operates like this: After cleaning and inspection for flaws that might show in an enlargement, a slide is inserted into a holder and scanned twice by three lasers (red, blue and green) at once. The first scan records density range; the second, color information. The laser signals are converted to electronic signals, processed and fed back to the lasers. Then they scan/expose a frame of Vericolor II Type S 70-mm negative film. The process takes less than 20 seconds. An enlarger then makes a print from the later-exposed negative the way it would with a conventional internegative.

While lasers are the glamourous part of the printer, electronic circuitry is its heart. Lasers provide tiny beams of spectrally pure light, which, for a 35-mm slide, translates into about 20 million optical bits of information per laser beam.

According to Alex W. Dreyfoos Jr., PEC president and LaserColor's codeveloper, the electronics are designed to convert the image on the slide to the information of the original scene. When circuitry drives the lasers to expose the negative, it's like taking the original picture.

That's a lot to swallow, so let's go over it. When you take a photograph, the film records the information of the scene, but not perfectly. If you take a picture of the picture (as when making an internegative), the imperfect information is recorded imperfectly. But suppose you knew that if a given film records a scene a certain way, you could work backwards and know what the original scene looked like. Then you could make an internegative essentially the same as taking the picture.

Dreyfoos claims the laser printer with electronic circuitry, does just that. He says he can use electronics to make up for the imperfect light absorption by film dyes so that exposing the internegative with lasers is as faithful to the original scene as exposing it with a camera!

Claims like that demand proof, so we had several slides printed by LaserColor, Cibachrome, R-printing and C-printing and compared the results. All work was done by professionals experienced with the respective processes.

Each LaserColor print was superior to its competitors, though not always by a lot. In fact, all processes gave good results. But PM staffers were unanimous in their preference for the laser prints.

The C-prints generally were everyone's second choice. Color fidelity was good and sharpness okay, though below that of laser prints. Interestingly, the C-print negatives were 4x5 inches, much bigger than 70-mm LaserColor internegatives.

Cibachrome did well, but prints tended to be dark and a bit oversaturated. One slide taken in the subway was tabbed by a lab person "too dark" to print well, but the laser print of this slide was, if anything, better than the original. R-prints lacked color fidelity and shadow detail. It should be noted that Cibachrome and R-printing kits are available for home use, which can cut per-print costs considerably.

Not everyone thinks LaserColor fully lives up to its claims. Steve Dunwell, a professional photographer with two books to his credit, told us he was disappointed with his experiences with LaserColor. He showed me some laser prints he'd ordered that lacked color fidelity, were decidedly unsharp, or both. He admitted, however, that a dye transfer of one of the same slides also came out poorly.

the wave of the future?

Dunwell's experience helps point out that some claims for LaserColor may be overstated, but it is a brand-new system and should be given a chance to mature. The basic concepts hold promise to be the dominant mode of photo processing in the not-too-distant future.

All other photo-processing systems are optically based, but regular noncoherent light can't make separate compensations in each one of a slide's three color-emulsion layers. However, laser light can. Since film characteristics can readily be represented mathematically, a computer programmed with this information could take a photograph, even badly over- or underexposed, and make a perfect internegative. Or, once the slide has been read in, the information could be manipulated many ways, much faster and more accurately than with chemical or physical means.

Basically, the laser printer does this now. It has programs for Kodachrome, old Kodachrome and all other chromes similar to Ektachrome. But there's no reason why it couldn't eventually be programmed for all films: reversal, negative and instant. PEC is now working on a direct printing process for lasers to expose photographic paper, skipping the internegative.

Going a step farther, the day will almost certainly come when cameras have solid-state electronic imaging sensors instead of film. Imagine a photofinishing system where you plug your imaging module into a unit that transmits the electronic information to the processor, which reads the information, manipulates it if necessary and then direct-prints your "photos" with lasers.

prints resembling paintings

The laser printer can now make straight prints and rescue many badly exposed slides (not usual with other methods). It can also make what PEC calls Art Prints—they resemble impressionistic paintings—at the flick of a switch. Such posterization with conventional methods is not very easy or cheap; with LaserColor it's as easy as making a straight print. PEC now offers over 3000 combinations of color and posterization.

Press accounts of LaserColor have played up this posterization technique, but our opinion was divided. The art staff liked the straight prints but were much more interested in Art Prints. Editorial types, lukewarm to Art Prints, were much more impressed by straight prints.

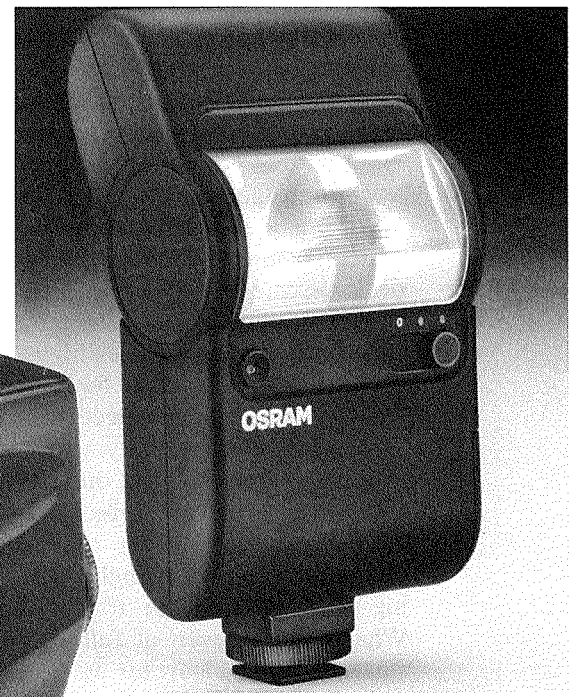
In summary, it seems that LaserColor, while not yet perfected, is well on its way to becoming an integral part of the photofinishing world. For price and product information, write PEC, Fairfield Dr., West Palm Beach, FL 33407.

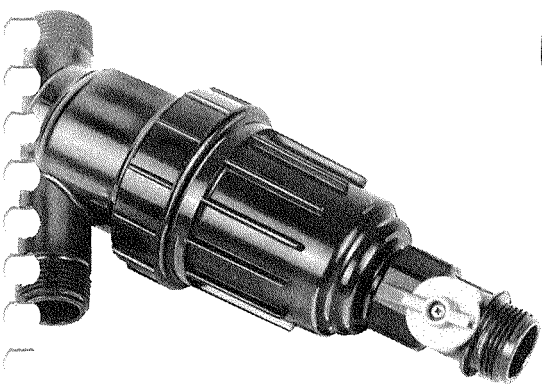
Five new photo products

PRECALIBRATED for many widely used photographic papers, the Beseler/Analite 300 is an inexpensive enlarging exposure meter. It allows preselection of enlarger lens aperture or exposure time and is said to be equally useful for color, as well as black-and-white printing. The meter sells for about $40. It's available from Beseler Photo Marketing Co., Inc., 8 Fernwood Rd., Florham Park, NJ 07932.

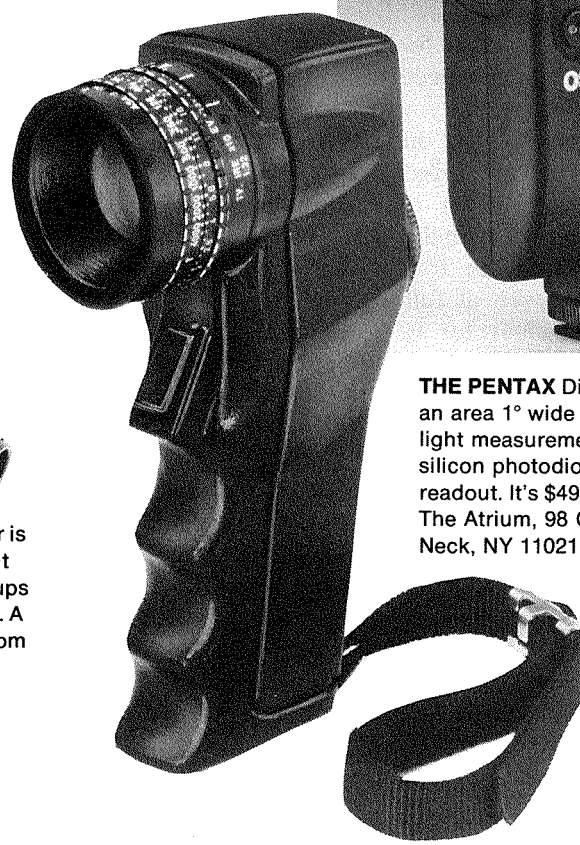
WITH MOST autofocus cameras, the picture subject must be centered in the frame. However, with a Chinon 35F-A 35-mm compact, you can focus on the subject, press a button to "hold" that focus and then frame the picture any way you want. It has a 38-mm f/2.8 lens, built-in flash and electronic shutter. It's about $270. Chinon Corp. of America, 43 Fadem Rd., Springfield, NJ 07081.

THE BCS25 electronic flash by Osram is one of a line featuring simultaneous bounce and direct flash. It has two automatic settings and can also provide bounce or direct flash alone. Four AA cells power the unit; guide number is 46 for ASA 25 film. About $90 from Hanimex U.S.A. Inc., 1801 Touhy Ave., Elk Grove Village, IL 60007.





THE UNITRON Universal Self-Cleaning Water filter is said to remove particles as small as 20 microns. It comes with all fittings required for temporary setups with kitchen faucets or more permanent plumbing. A built-in valve permits filter flush-out. About $18 from Ehrenreich Photo-Optical Industries Inc., 101 Crossways Park West, Woodbury, NY 11797.



THE PENTAX Digital Spotmeter scans an area 1° wide for precise reflected light measurement. The meter uses a silicon photodiode and has an LED readout. It's $490. From Pentax Corp., The Atrium, 98 Cutter Mill Rd., Great Neck, NY 11021.

New mini-stereo sets sound like giants

By HANS FANTEL

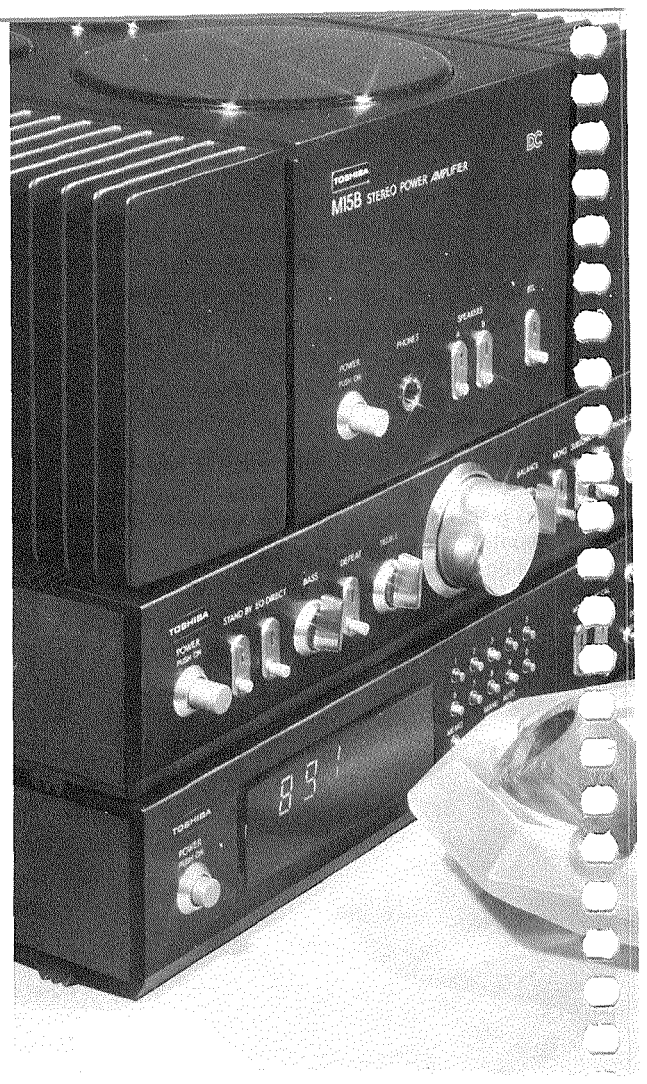
They've always said that good things come in small packages. These new mini-stereo sets take up less space than full-size units, but have full-size performance specs

■ TO PUT FIRST-RATE stereo sound into your home once meant cramming your living room with massive components. And if you happened to live in small quarters—a city apartment or a college dorm—the problem was where to stash all that equipment.

That problem has now been solved with the latest in audio designs, the so-called mini-components—tuners, amplifiers, receivers and tape decks—scaled down to the size of a cigar box. Typically, they're less than a foot wide and, in some cases, only 2 inches high. They look like toys—sound equipment for a doll house—tiny and delicate. You'd expect them to tinkle.

But turn them on and you won't believe your ears. These bantams put out big, honest sound. Only their size has shrunk—not their performance. Anything from rock to symphonies comes across convincingly, with nothing missing anywhere in the total sound spectrum. What's more, even at full volume the sound stays crisp and clear, for the new minis manage to keep the same low distortion specs as their bigger brothers. To sum it up, they are the first kind of quality sound equipment that actually fits on a bookshelf.

How, you ask, could it be done? First thing was to let out the air. Many regular components are lots bigger than they need to be. In fact, they're bloated. Look under the hood and you'll see plenty of empty space, partly because some marketing experts believe that the bigger the box, the better it sells. Aside from eliminating this waste space, designers of the minis resorted



TOSHIBA setup typifies sparkling appearance of these new minis. The performance is like the big guys—40-watts-per-channel with subsonic filters.

to the latest microminiaturization methods developed for computers and spacecraft, and they also came up with some new tricks.

For example, the normally bulky power supply—transformer and filters—was shrunk to a fraction of its former size by using new pulse techniques that let these circuits run cooler. With less heat to dissipate from their surfaces these items could be made much smaller.

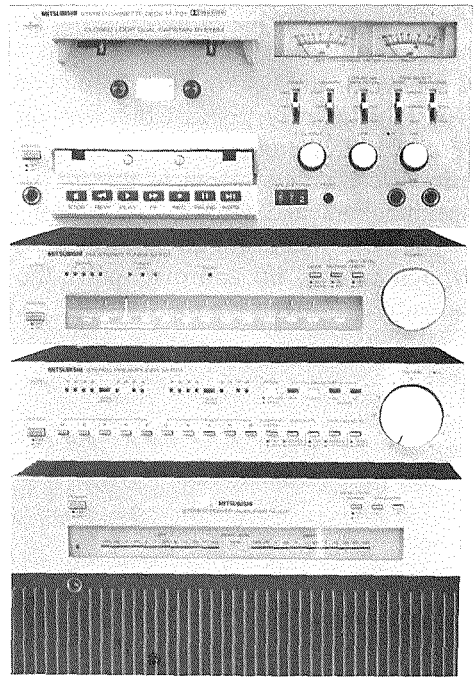
We checked out the five top brands: Technics, Mitsubishi, Sony, Toshiba and Radio Shack. With the exception of Radio Shack, which offers a nifty and inexpensive minireceiver (Model STA-7), minis come as separate components—tuner, preamp, and power amp. (In the case of Sony, preamp and power amp are combined in a single unit.) The separate components of each brand are matched in length and width so they can be easily stacked for maximum space economy. Or, just the tuner and preamp may be placed on a shelf, while the usually bulkier power amp can be stashed out of sight—maybe under a bed or sofa.

Looking at these little boxes, you naturally

RADIO SHACK'S STA-7 was the lowest priced outfit we examined. It proved to be a very good value for the cost-conscious mini-shopper. It's usually sold with the small speakers shown.

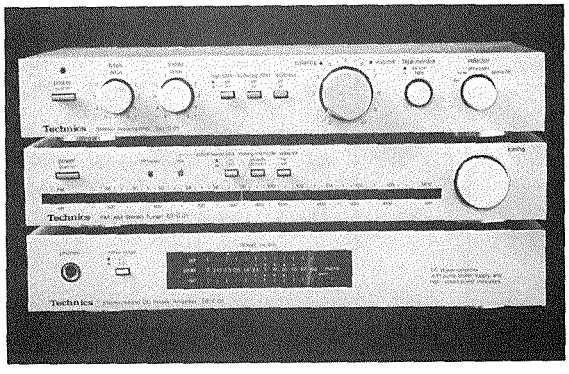
wonder if these pygmies develop any real sonic muscle. So it comes as a surprise that Mitsubishi, the most powerful mini, develops 70 watts per channel—plenty for most home listening situations. Sony delivers 50 watts per channel (wpc), and Technics and Toshiba are rated at 40. Granted, this won't shake the rafters or register on the Richter scale, but with efficient speakers it fills even a big room with clean sound at realistic loudness levels. Even Radio Shack's STA-7, rated at a modest 10 wpc, sounds very good at moderate volume, but strains a bit if pushed to extreme loudness.

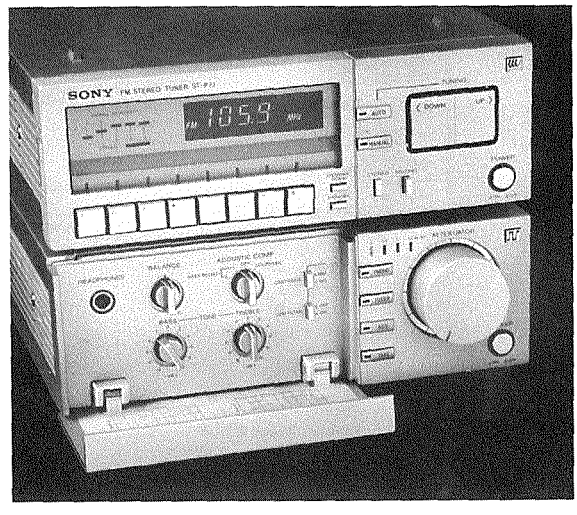
In any case, sheer power isn't what minis are all about. The important thing is that in all other aspects they more than hold their own against full-sized competition. Take the tuners, for instance. Sony, Mitsubishi and Toshiba all use digital synthesizer tuning circuits—a refinement



MITSUBISHI offers a complete set, including a cassette deck, only 10 inches high. Power is a giant 70 watts per channel and it has such advanced features as pushbutton controls and LED power indicators.

THE TECHNICS set (below) has 40 watts per channel with high and low filters, balance and loudness controls and special LED power output indicators. The two Sony units (right) are a stereo tuner atop an integrated amplifier combining amplifier and preamplifier in one package.





still rare even on the big ones. It assures dead-eye accuracy in tuning even those faraway, hard-to-get FM stations. Since the digital synthesizer employs no variable tuning capacitor, but derives the tuning frequencies from quartz crystal vibrations processed by computer-type circuitry, it permits unconventional tuning methods.

On the Toshiba, for example, you punch in the station frequency you want on a touch pad, just as you would a telephone number. Sony provides preset tuning for up to eight of your favorite FM stations. You punch in the frequency of those stations after the scanning circuit reaches the right spot. After that, all you do is touch a single button, and the wanted station comes in.

Don't, by the way, confuse this with the primitive pushbutton tuning devices found on conventional car radios. Most of those operate as simple mechanical detents for the twirling tuning shaft, and the results are often hit-or-miss. Digital touch tuning, by contrast, pulls the exact frequency of a given station out of the synthesizer, thus assuring perfect, center-channel resonance between transmitter and receiver. Or, putting it differently, on a digital tuner it's simply impossible to mistune a station.

Neither Sony nor Toshiba tuners have conventional scales—merely digital readouts flashing the station numbers. And, carrying digital design to its logical extreme, these tuners don't even have tuning knobs. Instead, you hold down one button to let the tuner scan upward toward higher frequencies—another button if you want to scan down. A brief jab at either button makes the scanner step up or down in small steps so you can hit any station accurately.

This arrangement saves space on the mini's tiny front panel, but many listeners may find this kind of tuning less convenient than twirling the knob and watching the pointer slide across the scale. Of course, with preset tuning of your favorite stations, there's less occasion for twirling, even if it could be done.

Technics and Mitsubishi use conventional tuning dials and knobs, but even here you'll find

MINIS AT A GLANCE

	Size (inches, H×W×D)	FM Sensitivity (microvolts)	Power (watts per channel)	Price	Remarks
Mitsubishi					
M-F01 FM stereo tuner	2¾×10⅝×9¾	2		$340	Quartz-synthesizer tuning, FM only
M-A01 power amp	5⅛×10⅝×9¾		70	500	LED output level meters
M-P01 preamp	2¾×10⅝×9¾			370	Mostly pushbutton controls
M-T01 cassette deck	5½×10⅝×9⅝			560	Front-loading
Technics					
ST-C01 AM/FM stereo tuner	2×11 7/16×10	1.9		260	Active servolock tuning
SE-C01 power amp	2×11 11/16×9¼		40	360	LED power output indicators
SU C01 preamp	2×11 7/16×9			260	High and low filters; balance and loudness controls
Toshiba					
F-15 FM stereo tuner	2×10×8¼	1.9		360	FM only; quartz-synthesized touch-pad tuning
M-15 power amp	4¼×10×8¼		40	340	
C-15 preamp	4¼×10×8¼			300	Subsonic filter tone-control defeat
Sony					
ST-P7J FM stereo tuner	3¼×8½×13	1.8		500	Quartz-locked frequency synthesis with pushbutton tuning
TA-P7F integrated amplifier	3¼×8½×13		50	500	Tone controls behind hinged panel; extremely low distortion, 0.01% THD
Radio Shack					
System Seven STA-7 AM-FM stereo receiver	3½×16½×12	2.2	10	160	Remarkable performance for low-cost unit.

unusual refinements. Mitsubishi also has a quartz-controlled frequency synthesizer that locks onto each channel, and Technics features a different tuning method called Active Servo-Lock. As the pointer on the scale approaches a station, the servolock grabs hold of the incoming frequency and automatically adjusts the local oscillator to "hold" the station. Incidentally, except for Radio Shack's receiver, all the minis use tiny LED indicators in place of conventional tuning meters.

With typical sensitivity ratings of 2 microvolts or better (a lower figure means higher sensitivity) these sophisticated tuners do extremely well even in difficult receiving locations. Only the far cheaper Radio Shack STA-7 has a less-sensitive, conventional tuner section with a simple single-strength meter as the only tuning aid. In urban locations, near the transmitters, it holds FM stations quite steadily and sounds clean, but it is not at its best in fringe areas.

fewer frills

When it comes to operating controls, the problem is where to put them. There just isn't room for all the knobs, slides and switches normally studding full-size front panels. So you'll find fewer frills, but nothing essential is left out, and everything is neatly arranged.

In that respect, Mitsubishi is out front. Figuring that rotary knobs are inefficient—because you need extra space to get your fingers around them—Mitsubishi banned all knobs from its preamp except for the volume control. All other functions are adjusted by rows of small push-buttons, with tiny LEDs lighting up above the buttons so you can see the settings at a glance.

The Technics preamp has the most complete set of controls, including defeatable tone controls, high and low filters and loudness compensation. And Sony's integrated amplifier has probably the most impressive specification: an astoundingly low distortion rating of 0.01 percent THD. Other distortion ratings in this group typically lie between 0.02 and 0.05 percent, which is excellent, and even Radio Shack's 0.5-percent THD at full output is quite acceptable. In the Sony design, a cooling system employs fluid traveling through a wick inside a pipe to carry off excess heat.

Cassette decks, as you'd expect, are more difficult to miniaturize, but Mitsubishi managed even that. Their Model M-T01 tape deck is small enough to stack with the other components in the line, although its height of nearly 10 inches makes it taller than most minis. Despite its compactness, there has been no skimping on either features or performance. The closed loop, dual-capstan drive accounts for smooth tape travel, with flutter and wow measuring a mere 0.05 percent. The result is rock-steady sound. With high-quality tape the frequency response is said to reach up to 25 kHz.

The M-T01 has solenoid controls that respond to even the slightest touch; separate bias and equalization adjustments for normal, chrome, and ferrichrome tape; facilities for mixing a microphone input with the line input, plus an unusual feature called ASPS (Automatic Spacing Pause System). This automatically mutes the input for about three seconds after the end of a musical selection, so that a consistent stretch of silence separates the different "takes" on the tape.

no miniprices

The only thing that's nowhere small enough on most of these minis is the price. (See chart on page 46. All prices were current at the time this was written.) Only Radio Shack's STA-7 is an outstanding bargain, at $160. Granted, the others are more powerful and more sophisticated in circuitry and features, but to us they seem overpriced. If you shop around, you can get equally good performance specs for a lot less among standard-size components. It shouldn't cost any more to make small components than any other kind, so it seems that we're asked to pay a premium for the sheer novelty of the minis. But as more come on the market, prices will drop or be discounted.

Finding suitably small speakers to go with these minis can be difficult. Lots of pint-size speakers have been introduced lately. Many are very good for their size, but few can do real justice to the sonic range of the minis.

For example, Radio Shack's STA-7 is usually sold as a complete system with a pair of their tiny Minimus 7 speakers. This combination sounds quite good, but the STA-7 would sound even better with a pair of efficient larger speakers. Likewise the other minis can do their best only with speakers capable of adequate bass, giving the sound the necessary depth and warmth.

If space is tight—the main reason for minis in the first place—you might consider small speakers with electronic-response tailoring, such as the KLH-3. Like the minis themselves, they provide full and ample range despite pygmy dimensions.

THE QUARTZ wristwatch at left is priced at less than $10, the other one at about $40 and the Tiffany clock at the top at a Tiffany price.

The magic of quartz watches

By NEIL SHAPIRO

■ IF MAN JUDGED the value of materials by their usefulness rather than their rarity or beauty, a quartz crystal would be more precious than gold. Though one of the Earth's most common minerals, quartz has the unique ability to help us keep accurate and reliable time.

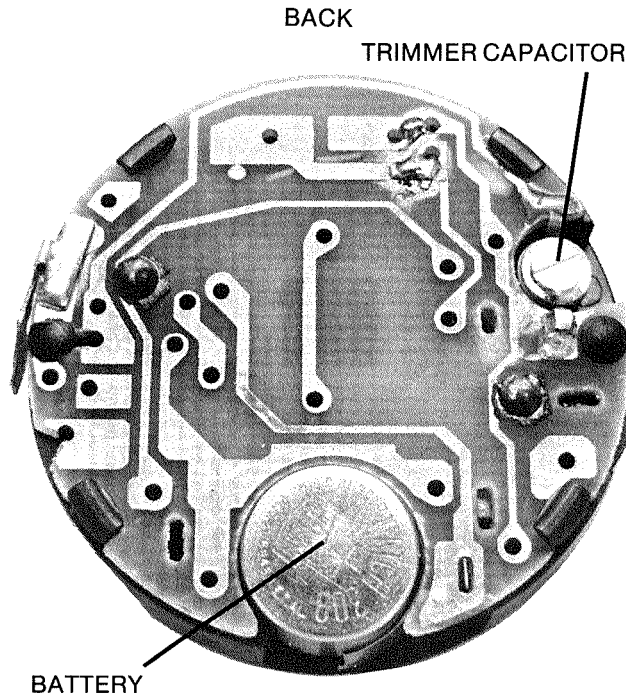
Quartz exhibits an effect known as "piezoelectricity." If a quartz crystal is subjected to an electric charge, it will vibrate. The frequency of these oscillations depends on how the crystal is shaped.

Controlled vibration is the key to timekeeping. Remember how the pendulum in a grandfather clock slowly oscillates from side to side. In an old-style wristwatch a mainspring slowly unwinds to oscillate a balance wheel. The more controlled and reliable the moving part, the more accurate the watch will be.

The quartz crystal in most quartz watches vibrates roughly 32,000 times per second (32 kHz) when the battery applies voltage to it. A good quartz watch depends on a tiny integrated circuit (IC), as well as an accurately cut and mounted quartz crystal.

First, 15 stages of the IC each divide the 32,000 vibrations by two—one stage after the next. Finally, the result is the familiar one pulse per second.

The divided-down current from the IC goes to the time display. The digits of the LED (light-emitting diode) or LCD (liquid crystal display) require no moving parts—only guidance from the IC—to display time and other functions. For those who prefer to see familiar watch hands, there are analog watches that do have moving



TRIMMER CAPACITORS are adjusted at the factory. You can realign them if you dare. But beware, they are extremely delicate.

parts. As the LED and LCD displays have no moving parts, they are usually more reliable.

All but the worst quartz watches will outperform even the best mechanical ones. How good a quartz watch is depends on several factors.

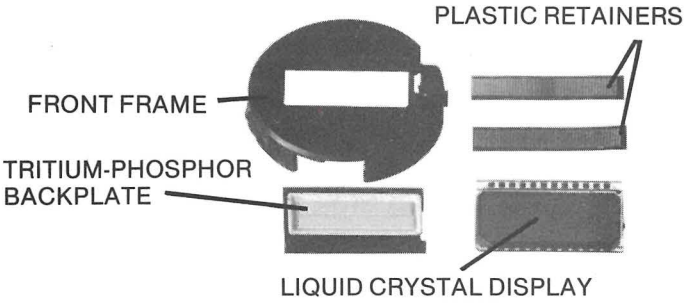
A quartz crystal, like wine, must spend some time in its circuit before it settles down to reliability, an aging process accounted for during factory adjustment. The crystal must be cut properly and contain no flaws affecting its operation.

When you buy a quartz watch, you pay for the electronics, the quality control and, of course, the jewelry (which can really inflate the price). A solid-gold case is going to cost much more than gold paint, and a plastic case will be cheapest. If in two watches the jewelry is equal in value, if they have the same number of functions, and if both come from reputable sources, then the likelihood is that their prices should be about the same.

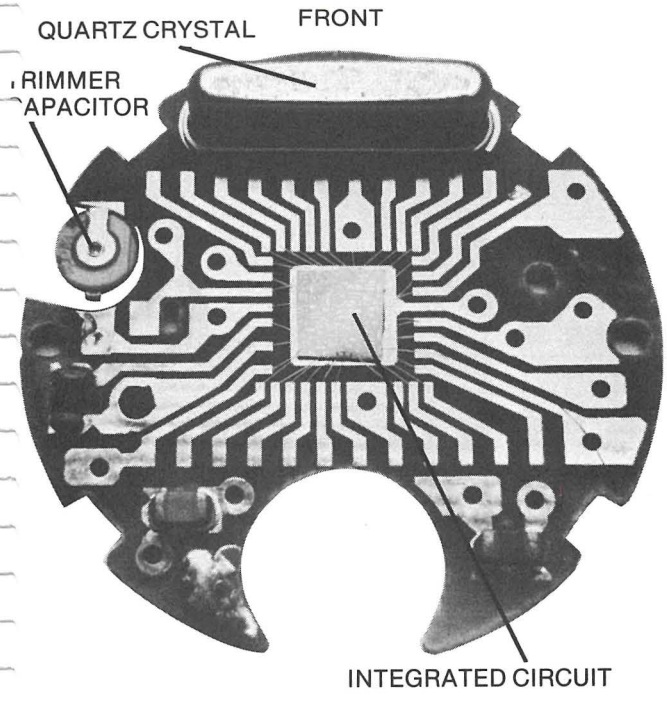
Can you tell whether an inexpensive watch you plan to buy is a dog or a winner? Unfortunately, there's no way to tell without actually using the watch for a while. The best yardstick before buying is the manufacturer's reputation.

The very best quartz watches will be accurate to within one to two seconds a month. Any good quartz watch should give you accuracy within 10 seconds. A real dog is only going to be accurate within 30 seconds. If you have a watch that didn't keep good time at the start, it probably never will. If an accurate watch "goes out" on you—and you have not dropped it (a crystal can break, given a good enough jolt)—it may only need a simple adjustment. If the watch cost enough to merit it, take it to a professional repairman. If it's a $10 job, it may make good sense for you to try to adjust it yourself.

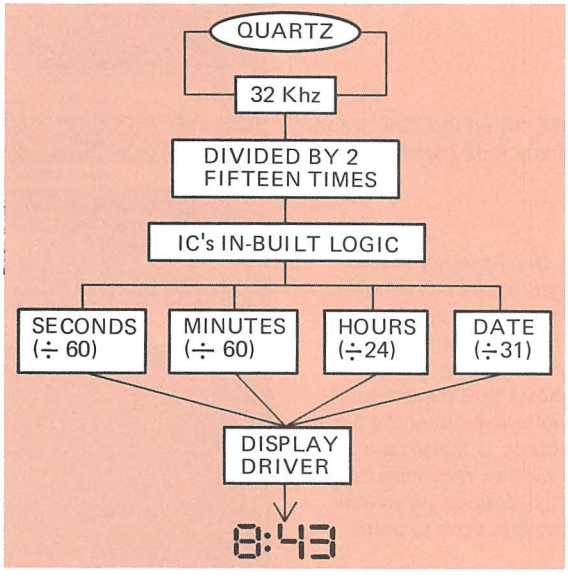
Open the back and you should see a small trimmer capacitor. This is adjusted with a tiny screwdriver and compensates for variation in the quartz crystal. *Carefully* turn it a quarter turn, then note if the watch gains or loses. Keep carefully adjusting. *Do not* try this if ruining the watch will annoy you—that trimmer is delicate.



THIS WATCH'S front frame encloses a liquid crystal display and a tritium-phosphor backplate. The assembly sits atop the electronic printed-circuit boards.



THE INTEGRATED circuit, beneath its mirror-like sheen, is a tiny computer that deciphers the vibrations of the quartz timing crystal.



THE QUARTZ crystal oscillates about 32,000 times per second (32kHz). This is divided down by stages to attain a single pulse per second. The integrated circuit uses this pulse to drive the display.

The breakthrough in audio tapes

You've been hearing about how great the new non-oxide recording tapes would be—and now they're here. Do they measure up to the forecasts? We took one from TDK to our lab to find out. Here are the results

By HERB FRIEDMAN

SPOOLED in a cassette it looks like any other cassette tape. But the similarity ends there, for *metal tape* delivers fantastic high fidelity from your cassette tape system!

Because of the inherent reduced maximum output level (called MOL) at the higher frequencies, cassette tapes and recorders are generally consumer-tested with signal levels well below the maximum record level indicated by the recorder's own meters. This is illustrated in Fig. A. The tape is high performance TDK-SA. The top trace is the playback frequency response, when the record level is at the meter-indicated maximum record level. Note how the high frequencies are attenuated.

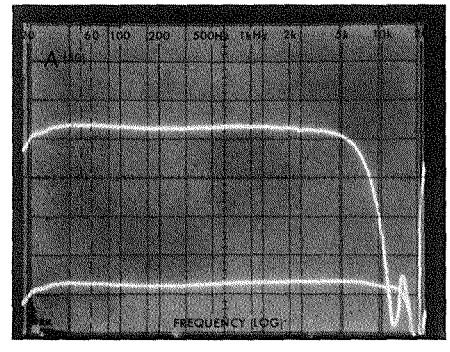
The lower trace in Fig. A is the same tape, with record signal some 20 decibels below maximum record level—the standard test level. Note that the frequency response is now within ±1 dB from 20 to 20,000 Hz. *It's this −20 dB frequency response that's generally used as the specification for tape and cassette recorders.*

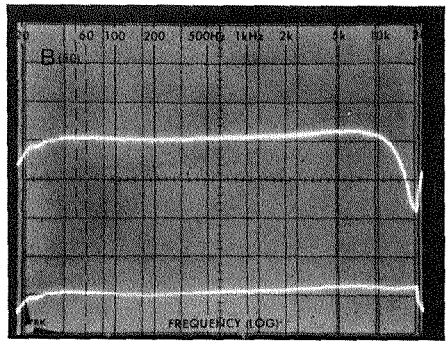
Figure B is the performance from the same recorder using TDK MA-RC60 metal tape. The top trace, representing maximum output level, now goes out to 15,000 Hz, where it is only 2 dB below the midrange frequencies. The bottom trace, which is the standard −20 dB test level, is still "flat" at 20,000 Hz. From any viewpoint, Fig. B represents superb cassette performance, and it can only be attained from metal tape.

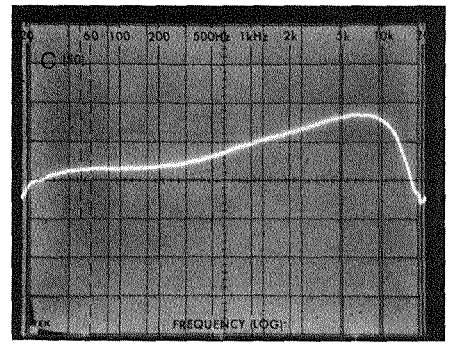
While metal tape recordings can be played on any recorder with a switch selector for chromium dioxide, Ferrichrome, or chrome-bias tapes, metal tape cannot be recorded on a conventional recorder. The poor response of one that was, is shown in Fig. C.

Metal tape requires a stronger erasing field and bias current. A conventional tape recorder cannot completely erase a metal tape recording. It also cannot bias the tape for optimum frequency response you get from metal tape, if you use it on a conventional recorder set for chrome-bias tapes. (It's even worse if the recorder is set for "normal," or ferric tape.)

WE tested the TDK-brand metal tape (right).







A Oscilloscope oxide-tape traces show how those tapes distort highs at high outputs. **B** Metal-tape response shows that distortion of highs is minimal at a high output. **C** Metal-tape playback response from recording on nonmetal-capable deck is poor.

SECTION 2

GREAT PROJECTS OF THE YEAR

On the following pages you'll find the finest of the famous Popular Mechanics projects:

Projects to improve your home
Projects to challenge your craftsmanship
Photo projects
Electronics know-how
Projects just for fun

You'll also find how-to information in related fields:

Shop know-how
Tool techniques
How-to tips for the great outdoors

Turn the page to find the first article on home improvement—and go on from there!

A family roomful of ideas

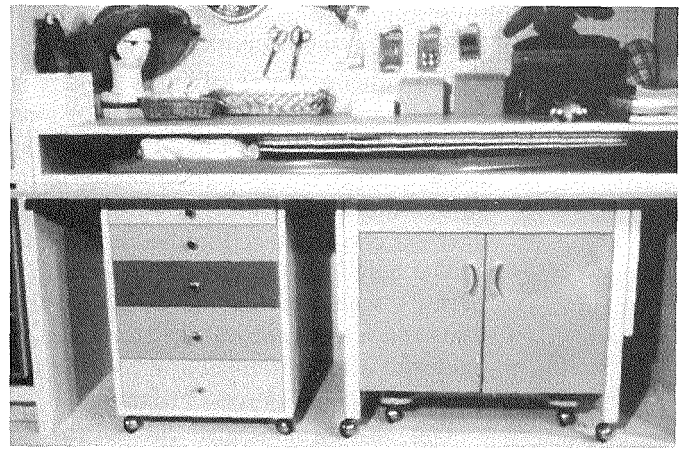
By HARRY WICKS and DESIGNER SHIRLEY REGENDAHL

■ BECAUSE OF THE HIGH COST of a mortgage these days, many homeowners who need more space are improving rather than moving. Many folks look at both the garage and basement as ways to gain a room without having to pay for an extension. The major pitfall of creating a room in either of these areas is that both usually lack sufficient light. Your room can take on a drab, cave-like feeling unless it is carefully decorated.

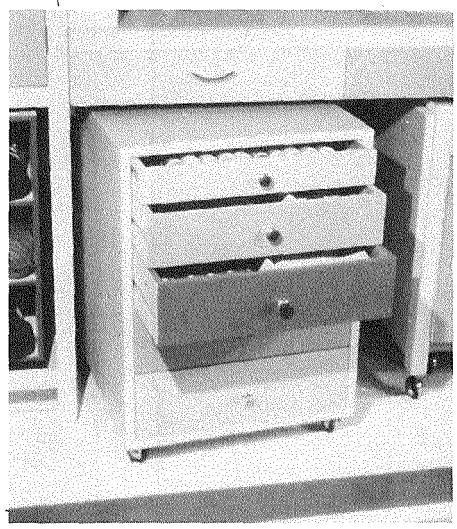
To counteract such negative feelings, designer Shirley Regendahl suggested a paint and color plan for this room that is both visually exciting and durable. We used semigloss latex paint on all of the built-ins and a soft eggshell finish in warm white on the floor. (Semigloss paint has a soft sheen with a reasonably high reflectance value; it tends to diffuse existing light and helps to brighten dark areas.)

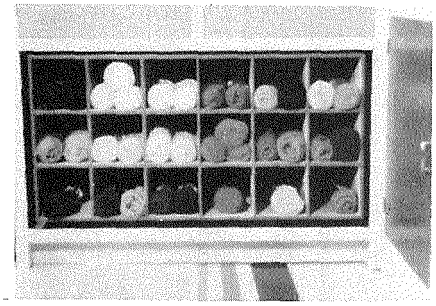
To make our family room extra-practical, we designed it to serve as a bedroom for unexpected overnight guests. The feature that sets our room apart is the well designed sewing center wall. Plans for the complete sewing center are given on the following pages, and you can duplicate the wall in whole or in part.

The wall consists of two end cabinets flanking a handsome, practical countertop with hidden ironing-board storage. The attractive sewing cart, its companion bench and the accessory storage cabinet store below the counter.



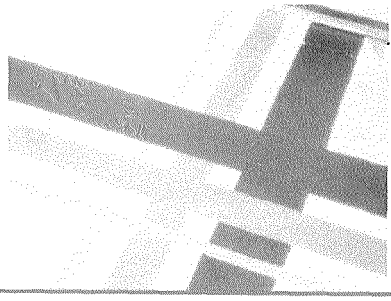
HANDSOME family room at left was conceived to transform a garage into much needed functional living space. You can select those ideas that may help you get more use from your living area. At room center there's a daybed which converts to sleeping for two, surrounded by a desktop over store-bought file cabinets. The wall opposite the desk becomes an entertainment center when the projection screen is lowered. The sewing center with its roll-about accessories cart (right) can be built from our plans.

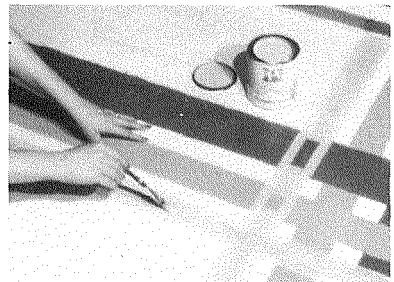




TO USE the sewing cabinet, it and its matching seat are rolled out into the room from beneath the counter (above, left). The photos above show the generous storage areas that we've built into the counter, sewing cart, yarn bin and accessories cabinet.

LOW-COST way to "carpet" a planked floor is simply to paint it. To counteract the cool effect of the blues used in our room, the floor was painted an off-white background and striped as shown below.





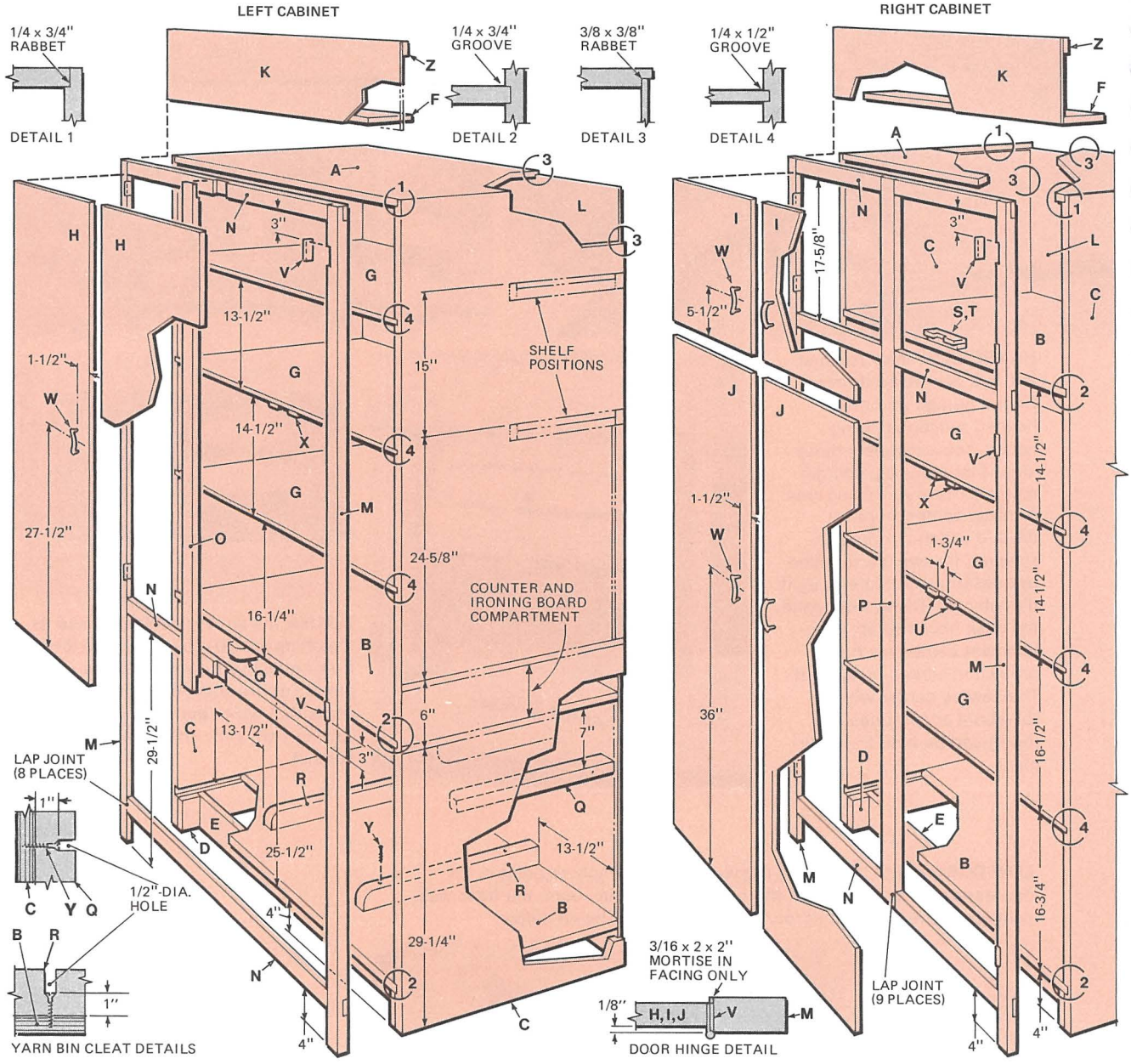
building the sewing center

The sewing center requires a floor space of 2×14 ft. and 8-ft. headroom. Dimensions can be altered, if necessary, to suit available space. A depth of 20 in. should be considered as minimum so that the sewing machine cabinet and chest of drawers can be stored under the counter.

The height of the end cabinets is 87 in. This permits maneuvering them into position. The 9-in. space between cabinet tops and ceiling is enclosed with a three-section cornice; the center one conceals a fluorescent lamp.

The sewing machine cabinet boasts clean lines. Its solidly supported drop leaves extend to provide a large working area of 20×60 in. A lift-out well top permits the machine to be recessed for flush surface sewing. With the top in place, the machine can be used for free-arm sewing. A small drawer in front of the well keeps small parts close at hand. The efficient doors have three-shelf storage compartments. A cushioned bench, also on casters, tucks neatly under the cabinet and stores the sewing machine.

Because it has an excellent surface for painting, we built the center of MDO (medium density overlaid) plywood. The material cuts without



splintering and its inner plies are free of excessive voids. Of fir, MDO plywood has its surface impregnated with a special resin which effectively conceals the plywood's characteristic wild grain. It comes surfaced on one or both sides. Surfaced-one-side panels have a tendency to warp and should not be used in cabinetry. MDO plywood costs a few dollars more than ordinary fir plywood, but is well worth the difference. Use clear pine 1×2 stock for stiles and rails on the cabinet front and for open shelves.

MATERIALS LIST—CHEST OF DRAWERS

Key	No.	Size and description (use)
A	2	¾ × 20 × 20″ plywood (cabinet top and bottom)
B	2	¾ × 20 × 24½″ plywood (cabinet sides)
C	1	½ × 18½ × 24½″ plywood (cabinet back)
D	2	½ × 6 × 18¼″ (drawer fronts)
E	1	½ × 5 ×18¼″ (drawer front)
F	1	½ × 4 × 18¼″ (drawer front)
G	1	½ × 2¾ × 18¼″ (drawer front)
H	4	½ ×6 × 18½″ (drawer sides)
I	2	½ × 5 × 18½″ (drawer sides)
J	2	½ × 4 × 18½″ (drawer sides)
K	2	½ × 2¾ × 18½″ (drawer sides)
L	2	½ × 5⅜ × 17¼″ (drawer backs)
M	1	½ × 4⅜ × 17¼″ (drawer back)
N	1	½ × 3⅜ × 17¼″ (drawer back)
O	1	½ × 2⅛ × 17¼″ (drawer back)
P	5	¼ × 17¾ ×18¾″ lauan plywood (drawer bottoms)
Q	1	¼ × 4 × 18″ (partition)
R	1	¼ × 4 × 17¼″ (partition)
S	2	¼ × 3 × 17¼″ (partitions)
T	1	¼ × 3 × 18″ (partition)
U	2	¼ × 2 × 17¼″ (partitions)
V	2	¼ × 2 × 11¼″ (partitions)
W	10	⅜ × 11/16 × 18½″ maple or birch glides
X	1	2½ × 17″ cove molding (tray)
Y	1	2½ × 4″ cove molding (spool tray)
Z	11	1⅝ × 4″ cove molding (spool trays)
AA	1	½ × ¾ × 4″ pine (filler block)
BB	4	casters, Shepherd Nova No. 9019, 2¼″ wheel, bright brass
CC	5	drawer pulls, Amerock BP 551-3
DD	10	No. 8 rh screws (adjustable door stops)

YARN BIN

A	4	½ × 23½ × 42¼″ (cross members)
B	2	½ × 22 × 23½″ (slides)
C	10	⅜ × 7 × 23½″ (partitions)
D	5	⅜ × 6¾ × 23½″ (partitions)

CENTER UNITS

A	2	¾ × 4 × 22¾″ plywood (cornice ledges)
B	2	¾ × 10½ × 72″ plywood (shelves)
C	2	¾ × 23¼ × 72″ plywood (countertop and bottom)
D	2	¾ × 4½ × 23¼″ (counter sides)
E	1	¾ × 4½ × 70½″ (counter back)
F	1	¾ × 6 × 71¾″ (counter front)
G	2	½ × 10⅝ × 22¾″ plywood (cornice ends)
H	1	⅜ × 10⅝ × 72″ plywood (cornice front)
I	4	¾ × 1⅝ × 72″ pine (shelf edges)
J	4	¾ × ⅞ × 10½″ pine (shelf cleats)
K	2	¾ × 1½ × 71″ furring (cornice cleats)
L	1	¾ × 3½ × 71″ pine (cornice lamp support)
M	2	¾ × 1½ × 20½″ furring (counter cleats)
N	2	¾ × 1½ × 69″ furring (perforated-board framing)
O	2	¾ × 1½ × 24″ furring (same as above)
P	3	¾ × ¾ × 21″ pine (same as above)
Q	1	⅛ × 24 × 72″ (perforated-board framing)
R	3	drawer pulls
S	1	magnetic catch

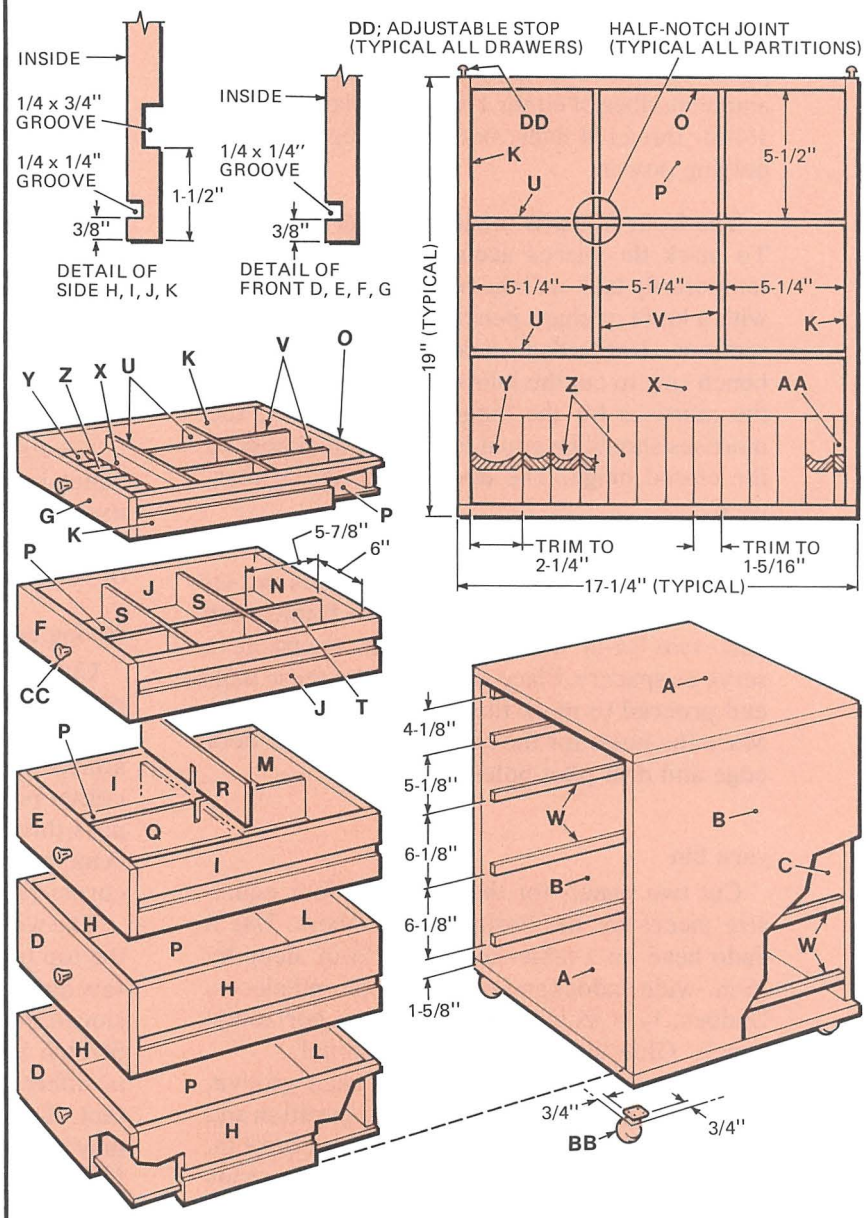
Misc.: 12 No. 10 1¼″ fh screws, 48″ flourescent lamp, toggle switch, pull chain.

end cabinets

Use a portable saw with a smooth-cutting plywood or hollow-ground blade to cut all parts. The cabinet sides are too large to dado and rabbet on a stationary saw so use a router with a straight bit instead.

Glue and 2-in. finishing nails are used to assemble the sides to the ¾-in. cross members, while 1½-in. nails are used at the shelf joints. Small pilot holes for the nails bored through the center of the dadoes simplify accurate nailing.

The cabinets are rather cumbersome, so try to have some help during assembly. Do it this way:



Lay one side on the floor and insert the horizontal members into the dry grooves. If your joints fit well, the pieces will stand in place. Add the other side panel, also dry, then start one nail at each joint. Remove the side panel, apply glue, then the nails. Set all nailheads.

With help, flip the unit over, keeping the unglued side in contact with the cross members. Again, start the nails, remove the side panel, apply glue, then nail. Check for squareness before the glue sets. If the unit is out of true, wrack it into alignment and nail a few strips of wood diagonally across the corners to hold unit square while the glue dries.

The cabinet will be a bit shaky until the back panel is attached. Install the latter using an ample number of either 1-in. galvanized nails or 1¼-in. threaded nails; both offer superior nail-holding power.

The front frame is made with half-lap joints. To mark the pieces accurately for the joints, temporarily tack-nail them into place, then mark with a knife or sharp pencil directly at the intersections. Use a dado head on a radial-arm or bench saw to cut the joints. Next, mark and cut the mortises for the hinges. The depth of the mortises should be equal to half the thickness of the closed hinge. The doors need not be mortised.

Glue the horizontal frame members into place, then add the verticals. Use finishing nails and set the heads. Install the hinges onto the frame, then place two 1½-in. finishing nails onto the frame to serve as spacers. Place the door onto these nails and proceed to mark the exact hinge locations. Mark the holes for the hinge screws in the door edge and drill pilot holes.

yarn bin

Cut two panels for the sides and four equal-size pieces for the horizontal members. Use a dado head on a table saw to cut ¼-in. deep by ½-in.-wide dadoes and rabbets in the end pieces. Dadoes, ¼ × ⅜ in., are cut into the horizontal panels. Glue the ends to the horizontals.

Apply a small bead of glue in each groove, then, starting at the bottom, insert a partition and drive a ¾-in. brad through the groove about 1 in. from each end. Use a nailset to seat the nails flush. To save time, prime and paint all inside surfaces before assembly. Take care to avoid getting paint in the grooves.

drawer chest

Cut all drawer members to size, then cut the dado in the side and front members to receive the bottom panel. On the sides only, cut a ¼ × ¾-in. dado on the outside surfaces. Assemble in this fashion: Glue and nail the sides to the backpiece. Apply glue to the grooves, then slide in the bottom. Add the front. Drawer guides of ⅜ × $^{11}/_{16}$-in. hardwood are installed in the sides of the chest. Paraffin applied to drawer grooves will make drawers slide smoothly.

Make the partitions and drop them into place; they need not be glued. Use cove molding as shown to make the thread-spool racks for the top drawer.

assembling the counter

Attach the sides to the back, then add the top and bottom. Cut the piece for the front, then run a shallow saw kerf, ⅛ × ⅛ in., lengthwise to simulate the drawer tops. Since stopped grooves must be made for the "drawer" ends, a router with a ⅛-in. straight bit is used. Clamp a guide board in place to guide the router. Install a 1½-in. × 6-ft. continuous hinge along the bottom.

roll-out bench

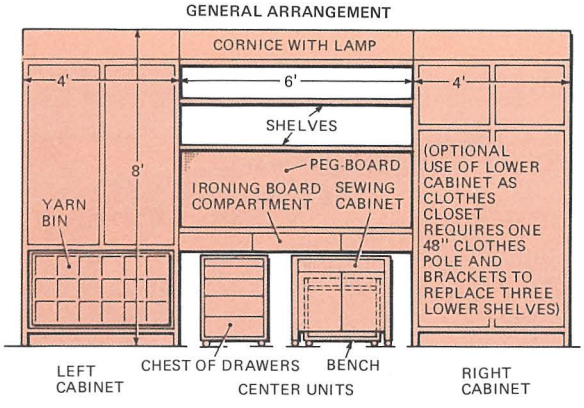
Except for the ¾-in. plywood bottom, the bench is of ½-in. stock. The thick bottom panel uses ¾-in. screws for plate casters. Cut heel indentation in bottom and round upper corners of sides before assembly.

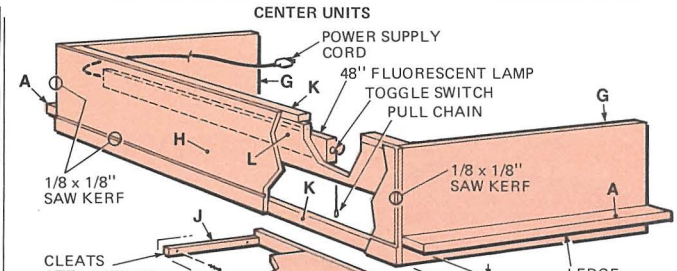
sewing cabinet

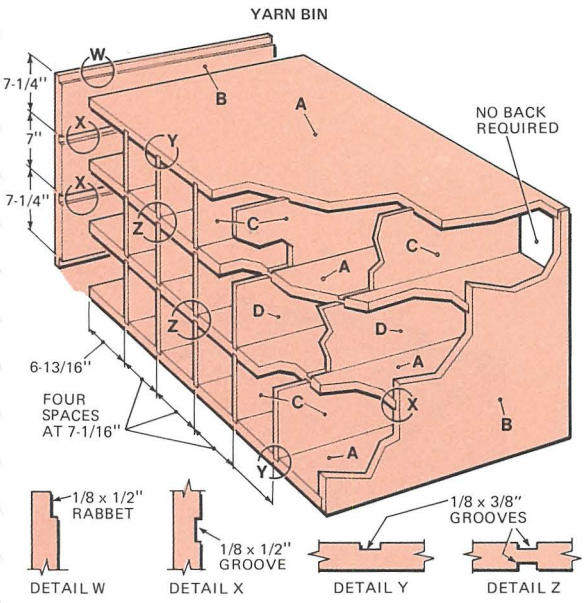
Cut the parts to size, then tack-nail the corner posts to the sides to permit sanding them flush. Do not glue them into place until the sides are attached to the back and subtop. Identify each corner post before removal. Cut the power cord pass-through holes in subtop and back, then assemble with glue and 2-in. finishing nails. Add corner posts.

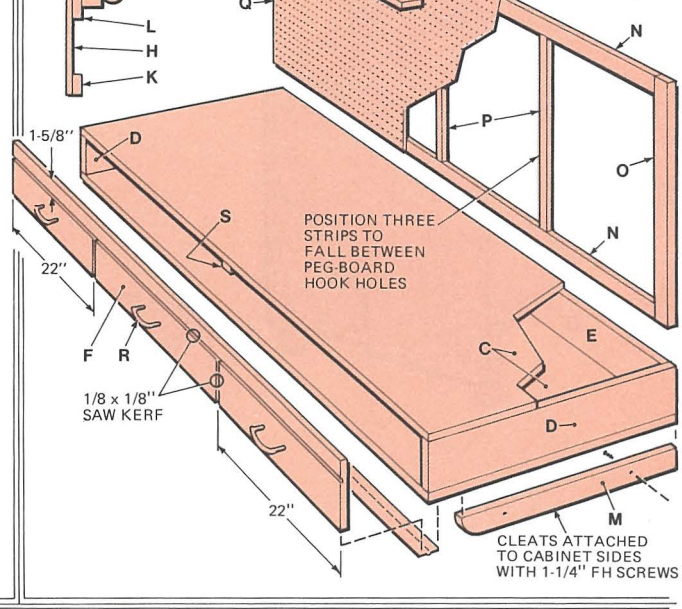
The well opening must be cut before attaching the top to the cabinet. This is done with a table saw and sabre saw. The outline shown is dimensioned for the J.C. Penney model No. 6915 Stretch Stitch sewing machine. If your machine is different, alter the dimensions to suit. Important: The spacing between the top and subtop may also have to be altered depending on the flush-plate height of the machine to be mounted.

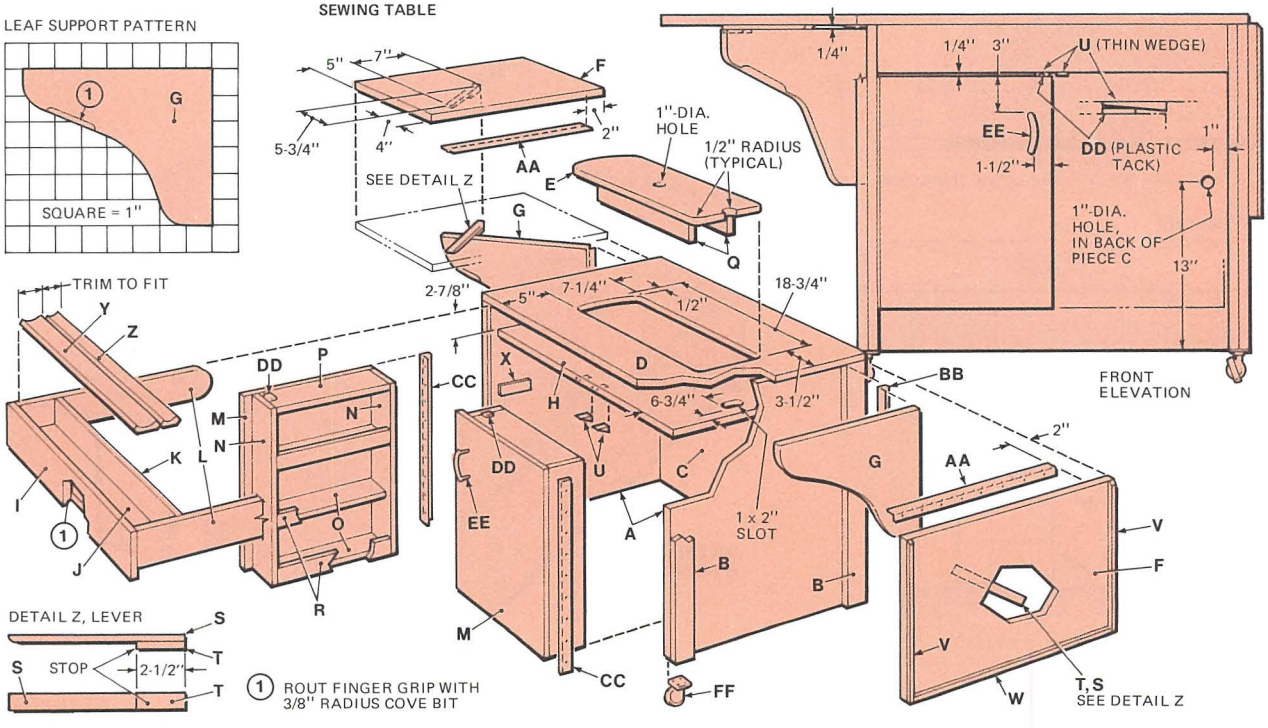
Bore four 1-in.-dia. holes at the corners of the cutout outline. Set the table-saw rip fence as required, depress the blade, then position the


GENERAL ARRANGEMENT
CORNICE WITH LAMP
4'
6'
4'
8'
SHELVES
PEG-BOARD
IRONING BOARD COMPARTMENT
SEWING CABINET
YARN BIN
(OPTIONAL USE OF LOWER CABINET AS CLOTHES CLOSET REQUIRES ONE 48" CLOTHES POLE AND BRACKETS TO REPLACE THREE LOWER SHELVES)
LEFT CABINET
CHEST OF DRAWERS
BENCH
CENTER UNITS
RIGHT CABINET

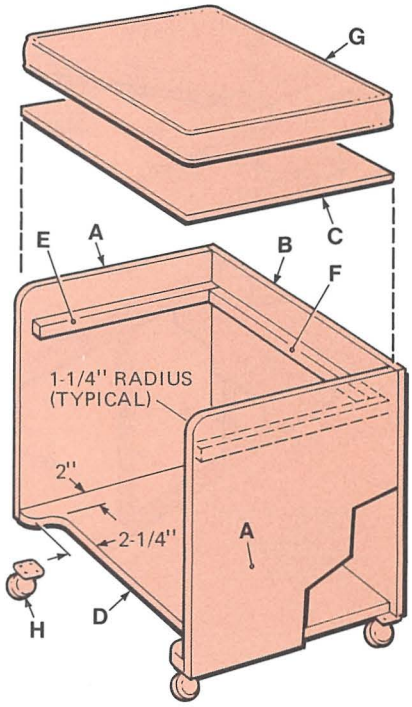

CENTER UNITS
POWER SUPPLY CORD
48" FLUORESCENT LAMP
TOGGLE SWITCH
PULL CHAIN
1/8 x 1/8" SAW KERF
1/8 x 1/8" SAW KERF
CLEATS ATTACHED TO CABINET SIDES WITH 1-1/4" FH SCREWS
1-5/8"
LEDGE RESTS ON CABINETS


YARN BIN
7-1/4"
7"
7-1/4"
NO BACK REQUIRED
6-13/16"
FOUR SPACES AT 7-1/16"
1/8 x 1/2" RABBET
1/8 x 1/2" GROOVE
1/8 x 3/8" GROOVES
DETAIL W
DETAIL X
DETAIL Y
DETAIL Z


CORNICE SECTION VIEW
1-5/8"
22"
POSITION THREE STRIPS TO FALL BETWEEN PEG-BOARD HOOK HOLES
1/8 x 1/8" SAW KERF
22"
CLEATS ATTACHED TO CABINET SIDES WITH 1-1/4" FH SCREWS

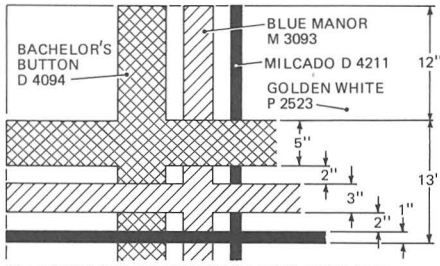

LEAF SUPPORT PATTERN
SQUARE = 1"
SEWING TABLE
SEE DETAIL Z
1"-DIA. HOLE
1/2" RADIUS (TYPICAL)
TRIM TO FIT
2-7/8"
7-1/4"
18-3/4"
6-3/4"
3-1/2"
1 x 2" SLOT
1/4"
U (THIN WEDGE)
EE
DD (PLASTIC TACK)
1-1/2"
1"-DIA. HOLE, IN BACK OF PIECE C
13"
FRONT ELEVATION
DETAIL Z, LEVER
STOP
2-1/2"
ROUT FINGER GRIP WITH 3/8" RADIUS COVE BIT
SEE DETAIL Z

SEWING CABINET BENCH



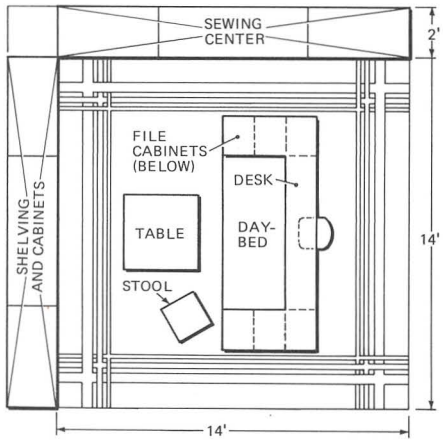
IRONING and pattern-cutting boards store neatly behind the drop-down false front.

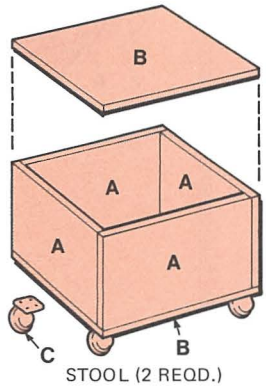
PAINT LAYOUT



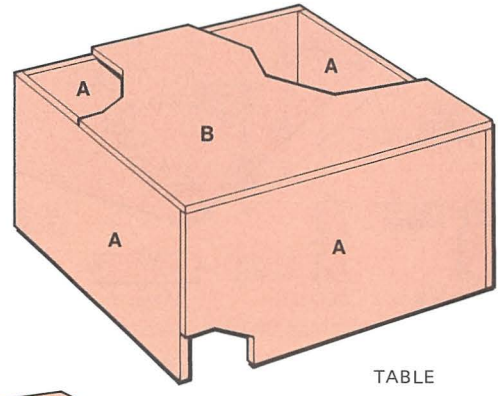
ALL PAINTS ARE PPG INTERIOR LATEX SEMIGLOSS

ROOM LAYOUT

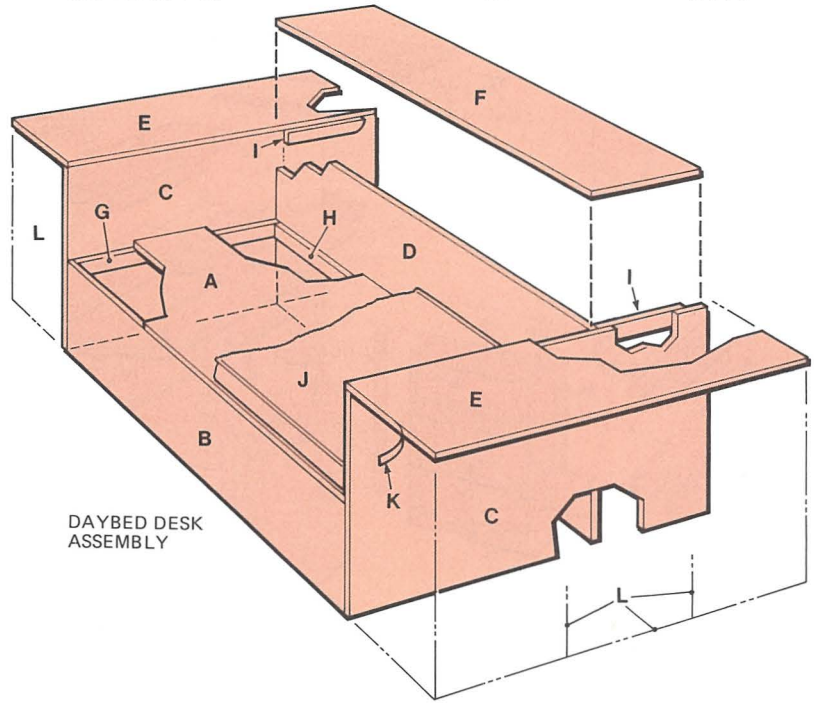




STOOL (2 REQD.)



TABLE



DAYBED DESK
ASSEMBLY

MATERIALS LISTS—STOOL

Key	No.	Size and description
A	4	¾ × 10¼ × 17¼" plywood
B	1	¾ × 18 × 18" plywood
C	4	Ball-type casters, Shepherd Nova No. 9019

TABLE

A	4	¾ × 20¼ × 35¼" plywood
B	1	¾ × 36 × 36" plywood

DAYBED/DESK

A	1	¾ × 30 × 75" plywood
B	1	¾ × 13¼ × 75" plywood
C	2	¾ × 28 × 45" plywood
D	1	¾ × 28" × 75"
E	2	¾ × 19 × 45"
F	1	¾ × 15 × 75" plywood
G	2	¾ × 1½ × 29¼" furring
H	1	¾ × 1½ × 73½" furring
I	2	¾ × 1½ × 12" pine
J	1	4 × 30 × 75" foam lounge pad
K		¾" veneer tape as req'd.
L	6	15"-wide × 18"-deep × 28"-high metal file cabinets

Misc.: 2" finishing nails, glue

SEWING CABINET BENCH

A	2	½ × 14½ × 18¼" plywood
B	1	½ × 18¼ × 23" plywood
C	1	½ × 14½ × 22"
D	1	¾ × 14½ × 22"
E	2	¾ × ¾ × 13½" pine
F	1	¾ × ¾ × 20½"
G	1	2 × 14½ × 22" foam cushion
H	4	Ball-type caster, Shepherd Nova No. 9019

MATERIALS LIST—END CABINETS

Key	No.	Size and description (use)
A	2	¾ × 23¼ × 47" plywood (tops)
B	4	¾ × 22⅞ × 47" plywood (cross members)
C	4	¾ × 23¼ × 87" plywood (sides)
D	4	¾ × 2¼ × 4" (kickplate end fillers)
E	2	¾ × 4 × 46½" (kickplate)
F	2	¾ × 4 × 43" MDO plywood (cornice bases)
G	6	½ × 22⅞ × 47" MDO plywood (shelves)
H	2	½ × 21⅜ × 54⅛" MDO plywood (doors)
I	2	½ × 17½ × 21⅜" MDO plywood
J	2	½ × 21⅜ × 60" MDO plywood
K	2	¼ × 9 × 48" lauan plywood (cornices)
L	2	¼ × 47¼ × 82⅝" lauan plywood (backs)
M	4	¾ × 1⅝ × 87" clear pine (facings)
N	6	¾ × 1⅝ × 48" clear pine (facings)
O	1	¾ × 1⅝ × 48" clear pine (facings)
P	1	¾ × 1⅝ × 83" clear pine (facings)
Q	2	1⅛ × $1^{13}/_{16}$ × 15" common pine (yarn bin cleats)
R	2	1⅛ × 2 × 20" common pine (yarn bin cleats)
S	1	⅜ × 1¼ × 5" pine (door stop)
T	1	½ × 1⅛ × 5" pine (door stop block)
U	2	⅛ × ½ × 2" pine (door stops)
V	6 pr.	$1^{3}/_{16}$ × 2" brass butt hinges
W	6	Pulls, Amerock BP419-3
X	6	Magnetic catches
Y	8	1½" No. 10 fh screws
Z	2	¾ × 1½ × 48" furring (cornice cleats)

MATERIALS LIST—SEWING TABLE

Key	No.	Size and description (use)
A	2	¾ × 20 × 25¼" (sides)
B	4	¾ × 2 × 25¼" (side legs)
C	1	¾ × 25¼ × $26^{15}/_{16}$" (back)
D	1	¾ × 20 × 30" (top)
E	1	¾ × $7^{3}/_{16}$" × $18^{11}/_{16}$" (well top)
F	2	¾ × 15 × 20" (drop leaves)
G	2	¾ × 12 × 14½" (leaves)
H	1	¾ × 18½ × $26^{15}/_{16}$" (subtop)
I	1	¾ × 3⅝ × 26¾" (drawer front)
J	1	½ × 3½ × 25¾" (drawer bottom)
K	1	½ × 2¼ × 25¾" (drawer back)
L	2	½ × 2¾ × 18¾" (drawer sides)
M	2	½ × 13¼ × 18" (door fronts)
N	4	½ × 3½ × 18" (door sides)
O	6	½ × 3⅛ × 11½" (door shelves)
P	2	½ × 3½ × 11½" (door tops)
Q	2	½ × 2⅞ × 13½" (well-top cleats)
R	6	⅜ × 1¼ ×11½" (door shelf backs)
S	2	⅜ × ¾ × 9" (leaf levelers)
T	2	⅜ × ¾ × 2½" (leaf leveler stops)
U	2	⅜ × 1 × 1½" (wedges)
V	2	¼ × ¼ × 15"
W	1	¼ × ¼ × 19½"
X	2	⅛ × 1 × 3" (spacers)
Y	1	$^{11}/_{16}$ × 2¼ × 25¼" cove molding
Z	1	$^{11}/_{16}$ × 1⅝ × $25^{1}/_{8}$" cove molding
AA	2	1½ × 15¾" continuous hinges
BB	2	1½ × 12" continuous hinges
CC	2	1½ × 18" continuous hinges
DD	2	⅛ × ½ × ¾" plastic tacks
EE	2	door pulls
FF	4	2¼" plate-type casters, Shepherd Nova No. 9019

work and turn on the power. Slowly elevate the blade to make the blind cut to within 1 in. of each hole. Finish cuts to the corners and make the curved cut with a sabre saw.

If you salvage the dropout piece, you'll have a perfect-fitting well-top insert. Make diagonal cuts at the corners to clear away holes. Glue-in small corner blocks; trim to size.

It would be very difficult to drill the holes for the drop-leaf hinge screws in the tabletop after it is attached because of the closeness of the cabinet side. Therefore, do this in advance. Also, temporarily turn in the screws so they'll be easier to drive in the tight space during final assembly (after painting).

A router with cove bit is used to cut a finger grip on the edge of the leaf support. A cove is also routed at the bottom back edge of the small drawer because a pull is not used for this drawer (it would tend to snag cloth during a sewing session). When you assemble shelved doors, start by attaching the front strips to the shelves, then add the sides and finally the fronts.

installing the cornice

The cornice is made in three parts. The end sections utilize ¼-in. lauan cutoffs from the cabinet backs. The center unit is faced with ⅜-in. plywood. A kerf cut along length and at ends produces shadow lines for a decorative effect. A 4-ft. fluorescent lamp with toggle switch and short pull chain completes the project.

coffee tables, stools, daybed

These pieces are all built using sturdy ¾-in. MDO plywood cut and assembled as shown in the drawings. Assembly is with glue and 10d finishing nails; set nailheads and fill depressions with wood patch before painting. If desired, the stool tops can be fitted with a pair of cleats below and permitted simply to "float" in the cube.

Install veneer tape or glue and tack strips of ¼-in. lattice on all exposed plywood edges to hide plies.

To finish the units, do this:

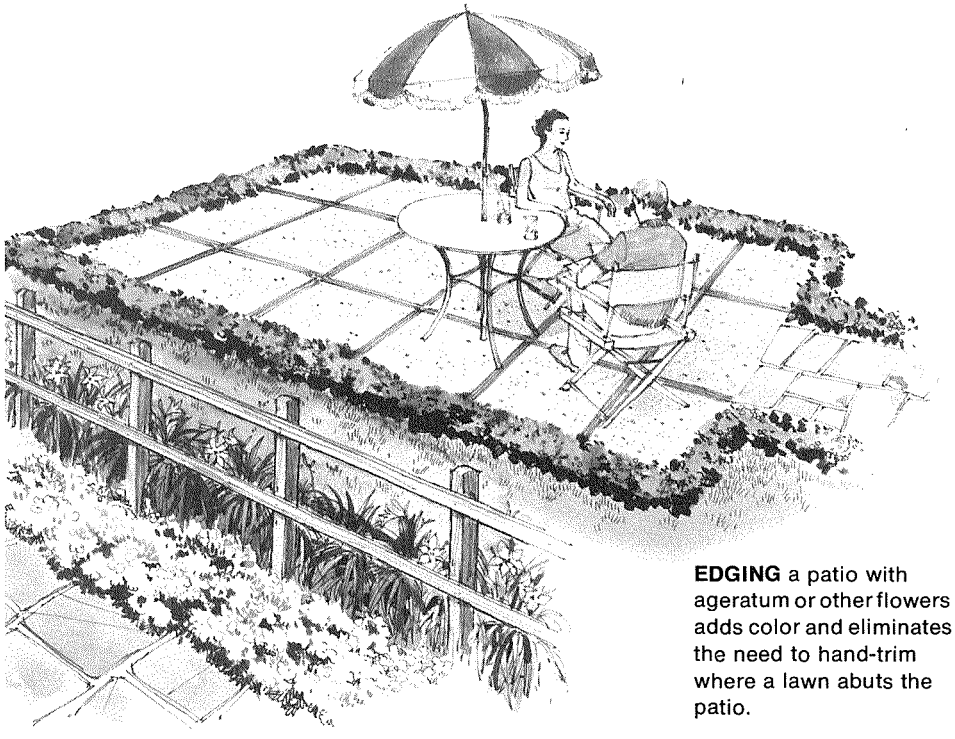
- Sand all surfaces smooth, dust off and wipe with a tack cloth.
- Prime all exposed plywood edges with a pigmented shellac such as Bin or Enamelac.
- Prime-paint all surfaces with a white water-base interior enamel undercoater.
- Apply color paints of your choice or duplicate our blue room. Here is a list of the colors we used: From Pittsburgh Paints' DesignaColor System, blue colors (from darkest to lightest) are Bachelor's Button D4094, Blue Manor M3093, Tiny Thistle P2097, and Sweet Bluette P2095. Floor is Golden White P2523; orange striping is Mikado D4211.

Neat solutions for edging problems

By D. X. FENTEN

WALKS, DRIVEWAYS, patios and swimming pools have one thing in common—all have edges which, if not properly planned, installed and maintained, can ruin the look of an otherwise well-kept landscape.

There are many solutions to the edging problem. One crisp edging requiring no materials or plants is made by accentuating the cut edge of the lawn. With a flat spade or a power or half-moon edger, you can cut this edge around trees and shrubs, along the borders of vegetable gardens and flower beds or wherever an edge would give a clear look. This treatment is fine for a while, but it requires periodic maintenance.

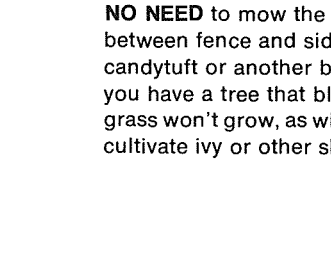


EDGING a patio with ageratum or other flowers adds color and eliminates the need to hand-trim where a lawn abuts the patio.

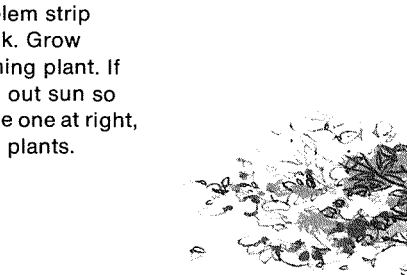
edging materials

Considerably more permanent are edges made of brick, patio block or special edging block. Lay these directly into the soil, or on a 2-in.-thick bed of carefully leveled builder's sand. Mortared joints are optional when blocks are placed on sand. Metal and vinyl stripping edges are also available.

NO NEED to mow the problem strip between fence and sidewalk. Grow candytuft or another blooming plant. If you have a tree that blocks out sun so grass won't grow, as with the one at right, cultivate ivy or other shade plants.



1



2

3

1. RAILROAD ties are an attractive border for patio, walkway or garden. Bury them so that top surface is on grade (flush with ground). 2. Patio blocks give a trim appearance to plant borders. 3. Heart redwood and cedar edgings are rot-resistant. Or, consider the use of wood that has been pressure-treated.

Wood—especially heart redwood and dar, which are naturally rot-resistant—is an attractive edging material. eatment with a preservative further olongs its life. However, creosote, the mercury compounds and pentachlorophenol types give off fumes that are toxic to many plants. Pressure-treated ood isn't toxic to plants and also kes a good edger.

Position edging materials so they are nost flush with the ground. This gives ou a path for lawn mowers and eliminates hand-trimming.

een plant edgings

Plants and ground covers can soften hard, practical line of brick, stone nd wood, while not adding unnecesary maintenance. Several members of ivy family, pachysandra or trailing myrtle make ideal green edges. Plant se low ground covers 8 in. back from the edge of the area. These plants will soon spread. They'll need trimming en used close to driveways or walkways. If they are in full sun, be sure to ater them enough to prevent drying.

After you've snipped these edgings to keep them in bounds, root the cuttings a glass partially filled with moistened erlite. You may have enough seedling plants to edge other areas.

Putting plants along the edges of service areas pretties them up. But, when y are lush and fully growing, some nts will narrow the walk or driveway. Find out how the plants you are considng will grow: how wide, how tall, how trailing, how dense, how lush. Then measure carefully at planting time.

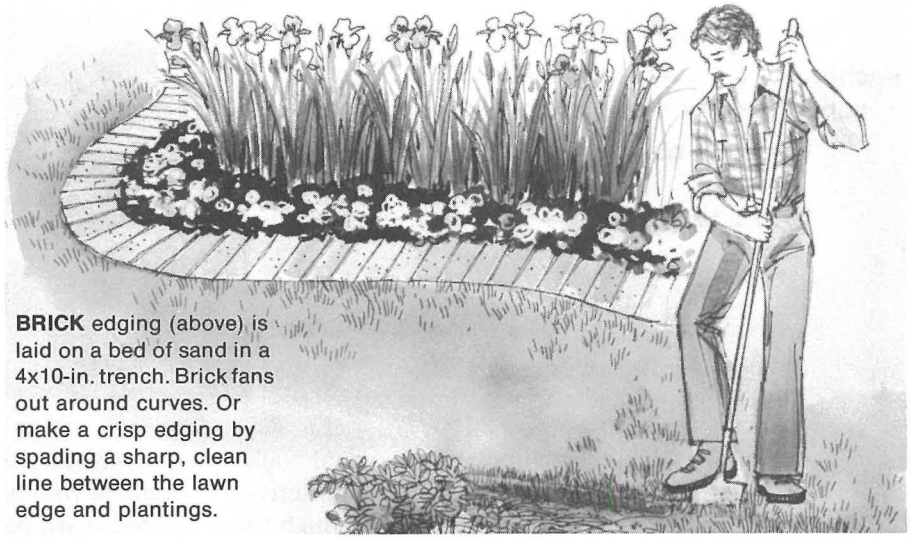
ging plants that flower

Some of the colorful plants that edge ll but don't encroach include: candyft, ageratum, lobelia and dwarf petunias. Speedwells in several varieties, al bells and nepeta are also fine edgers and don't spread.

Use a bulb planter to make flat-bottned holes for plant seedlings. A trowel will make conical holes, where pockets that dry out roots and kill plants can easily develop.

Immediately after planting, water the a thoroughly and keep it moist until the plants are well-established. Always nt some "in case" plants in another a for transplanting in the event several newly planted border plants die.

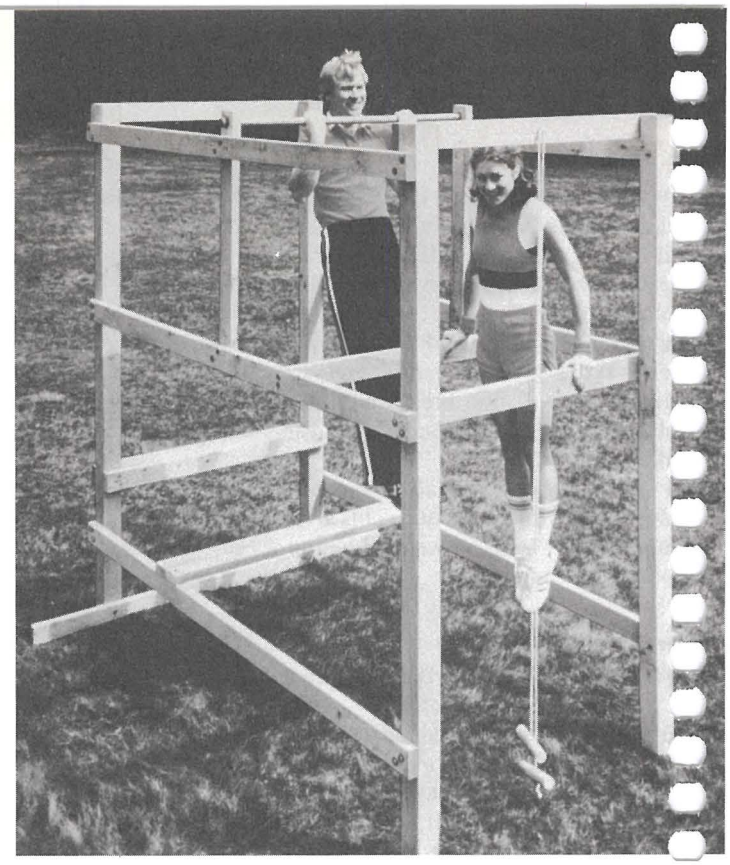
Later in the season when everything is growing, take a good, long look at your edgings and check that they are what you planned—full but not crowded. If you were a bit chintzy with the plants and they haven't filled in quite enough, add some more. If they are too full and seem to be crowding each other, do some thinning. Then, when everything appears to be perfect to your eye, take pleasure in knowing that the beauty and color you brought to your edging areas without much additional work is the added touch that will give your entire property a crisp, finished look. With minimal work you can keep edgings looking good all season.



BRICK edging (above) is laid on a bed of sand in a 4x10-in. trench. Brick fans out around curves. Or make a crisp edging by spading a sharp, clean line between the lawn edge and plantings.

SELECTED EDGING PLANTS

PLANT	HEIGHT (INCHES)	DENSITY	DESCRIPTION	CARE
Pachysandra	7	Quickly becomes dense carpet.	Evergreen groundcover. Individual plants, sawtooth leaves.	Virtually no special care. Likes moist, rich soil.
Ivy, English and Baltic	8	In a few years gives pretty foliage edging.	Handsome plants that grow together. Single plants that soon intertwine.	Easy care. Does very well in moist, rich soil. Shear to keep bushy.
Juniper, Wilton Carpet	5-6	Shortly becomes like silver-blue rug.	Silver-blue foliage year 'round. Several planted along walk provide natural edge.	Trim as required to keep in bounds. Give some sun and grow in well-drained soil.
Mugo Pine, Dwarf	18	If pruned it can become quite dense. Unpruned sometimes it looks scraggly.	Marvelous looking mound shaped plant of pine family. Good color.	Does well in sun or light shade. Prune to keep free of walk.
Barberry Dwarf	15	Very dense with spiny leaves. Can also be used as hedge.	Fantastic along walks. Shiny green leaves go to bronze in winter. Some have pretty berries for a long time.	Prune lightly to keep in bounds. Needs little care. Keep plants moist.
Boxwood	16	Very dense with tiny leaves.	Can be sheared to almost any shape. Stays trim. Lives a long, long time.	Some sun, some shade and moist soil will keep these thriving.



Keep fit on a homemade gym

Work out those muscles that jogging won't reach! Here's a compact exercise center that substitutes for the cross-country stations of an obstacle course

By BILL MANESS

■ JOGGING has some limitations, even though it has been called the perfect conditioning activity for the heart and lungs (vigorous enough to give the cardiovascular system a good workout, yet leisurely enough for almost anyone).

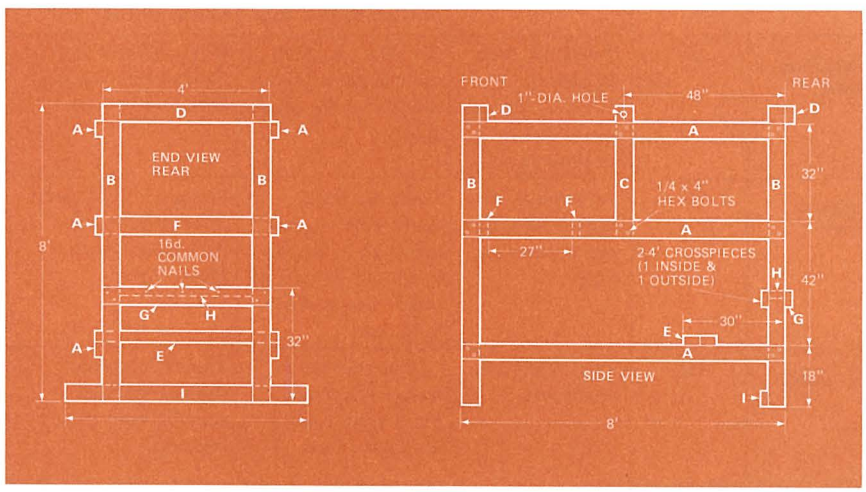
But running contributes little to flexibility and doesn't develop any significant muscle tone, other than in the legs. That's why the Swedes developed *parcours* (French for "course"), which consists of several exercise stations at intervals along a jogging path. The jogger stops for activities such as sit-ups, push-ups, chinning and leg lifts; a number of U.S. municipalities have installed parcours layouts in parks and along trails.

Unfortunately, the course is seldom located right in your neighborhood. But it's easy to have a backyard parcours of your own.

The multipurpose unit shown here combines the various exercise stations into one. It can be moved or disassembled, costs little to build, and will exercise every major muscle group that does not get a workout from jogging.

As shown in the plans, the backyard exerciser requires only minimal carpentry skills.

Select lumber that is straight and relatively free of knotholes. Ordinary yellow pine is satisfactory, but pressure-treated pine, which costs somewhat more, will last longer. Precut lengths of 2×4 and 4×4 can be used with little additional

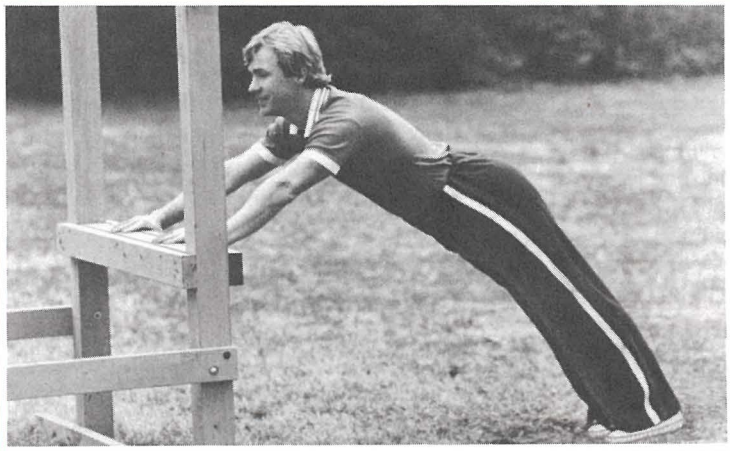


MATERIALS LIST—PARCOURS

Key	Pcs.	Size and description
A	6	2 × 4″ × 8′ (sidebars)
B	4	4 × 4″ × 8′ (upright supports)
C	2	2 × 4 × 40″ (chinning bar support)
D	2	2 × 4 × 48″ (front crosspiece)
E	2	2 × 4 × 51″ (step)
F	2	2 × 4 × 48″ (parallel bars)
G	2	2 × 4 × 48″ (hamstring stretcher)
H	1	2 × 4 × 41″ (hamstring spacer)
I	1	2 × 4 × 72″ (rear brace)
J	1	1″ o.d. × 50″ galvanized bar with 2 threaded end caps (pipe chinning)
	2	1¼ × 6″ dowel handles
	1	¼″ × 17′ nylon rope
	32	¼ × 6″ hex bolts with nuts and washers or 36 16d common galvanized nails

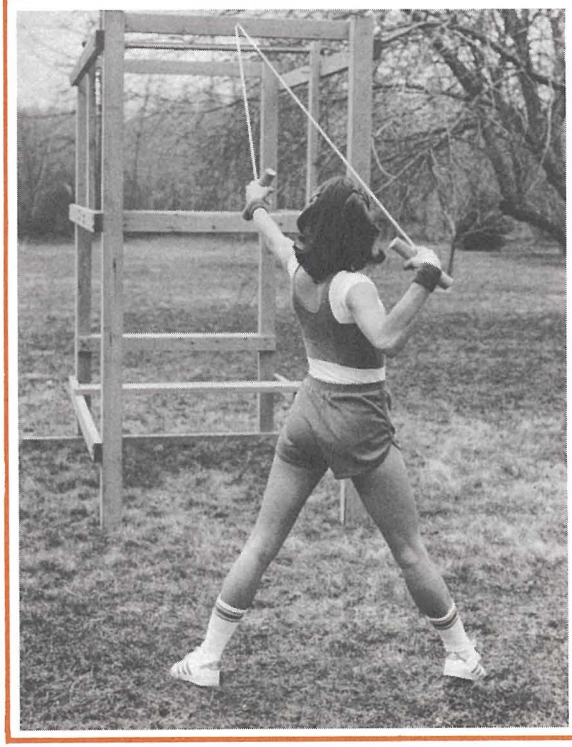
HAMSTRING STRETCH

THE HAMSTRINGS, the muscles in the back of your thighs, tend to tighten up during jogging. Consequently, they need to be stretched. Place the heel of one leg on the rear platform. Keeping that leg straight, bend slowly forward while trying to place your chin on your knee for about 10 seconds. Then you should repeat the exercise with the other leg.



HEEL CORD STRETCH

THIS STRETCHES both your Achilles' tendon and calf muscle. Stand three or four feet from the front parallel bar and lean on it. Rise up on your toes, then lower your heels to the ground, holding for several seconds. As you press down, you should feel the stretching. Bend your knees slightly and hold position for a few seconds.



ROPE PULL

THIS EXERCISE will tone the rhomboid muscles in your upper back that draw the arms backward. Grasp the handles on the ends of the rope and lean away from the structure with your hands together. Then spread your arms out to the sides to pull your body forward. Next, slowly bring your hands back together to return to the original position. Repeat this exercise as many times as you can comfortably, with up to 20 times a good practice session. Alternately pulling on the rope with each arm, both facing and with your back to the exercise unit, can flex and strengthen muscles in the arms, shoulders and hands. Practice with a comfortable, even rhythm.

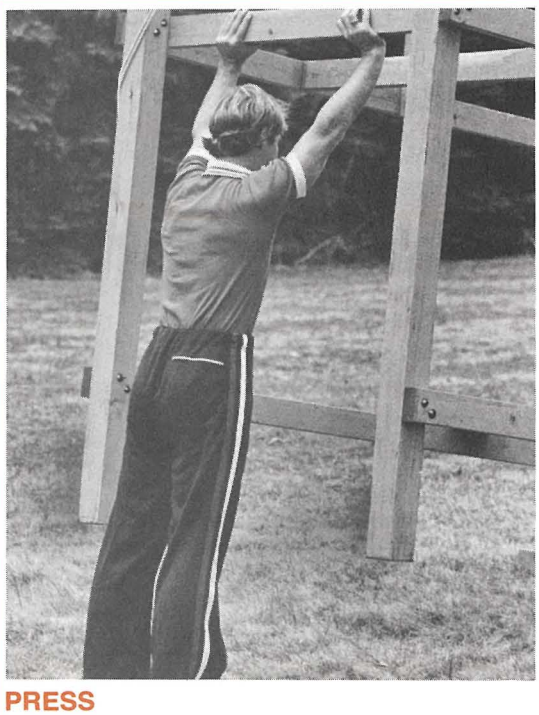
KNEE-UPS

YOUR WAISTLINE will trim up as this exercise firms up the rectus abdominus. Hang from the chinning bar and slowly draw your knees up toward your chest. Then lower them again. For best results, repeat as many times as you can. Up to 20 times at each session is a good goal.

sawing required. Drill pilot holes for all nails or bolt holes, to prevent splitting. Make liberal use of washers under bolt heads and nuts if the unit will be bolted together. Construction time should be less than eight hours. Angle irons at corners, plus cross braces can further stiffen the structure.

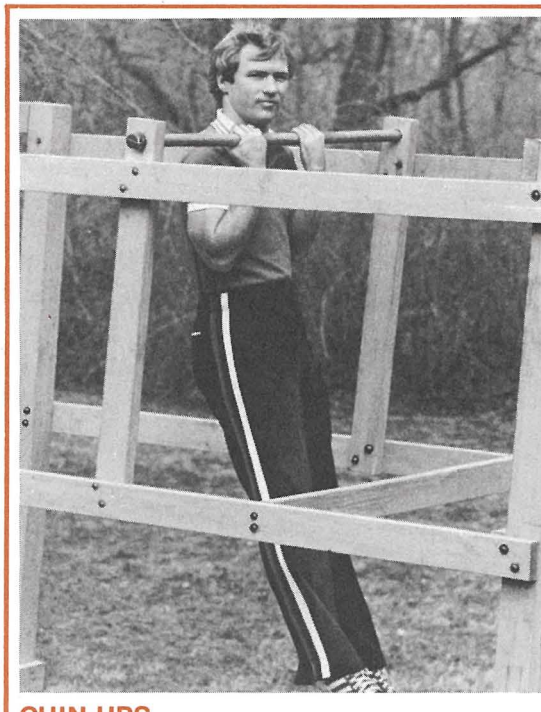
Six-inch dowels of about 1¼-inch diameter make good grips for the rope-pull exercise. Drill each with a ¼-inch hole through the center and thread through each end of a 17-foot length of nylon rope after running it through a 1-inch-diameter eye screwed to the top center of the front cross-piece. Rope grips should nearly reach the ground. A knot in each end of the rope secures them.

File, sand or plane the middle 12 inches of the tops of the parallel bars and other lengths used for grips or presses while exercising. Practice slowly at first as you work up stamina to supplement your jogging routine.



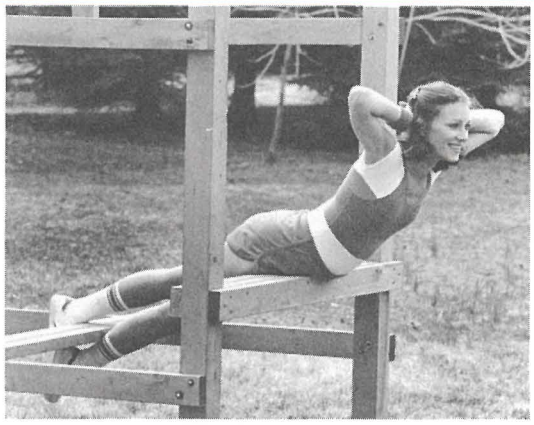
PRESS

THIS TWO-ARM exercise works out the deltoid and trapezius muscles in your shoulders. Grasp the front parallel bar on the underside at shoulder width. Press it straight overhead, lifting the front end of the structure, and then lower it. Repeat as many times as you can comfortably.



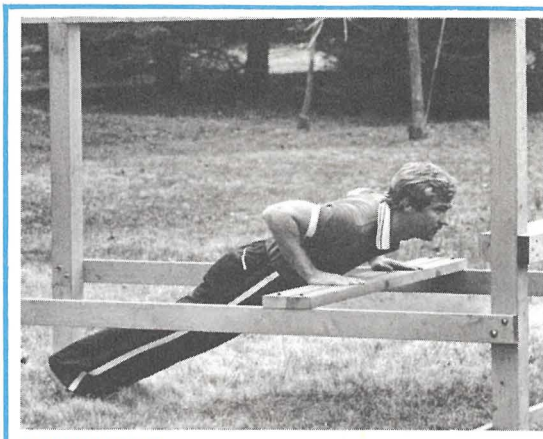
CHIN-UPS

CHINNING develops front arm biceps and broad back latissimus dorsi muscles. Grasp the bar at shoulder width, palms toward you. Pull up until chin clears bar as often as you can. To increase back muscle action, pull so bar is behind your neck. Turning palms back exercises biceps. Don't arch your back.



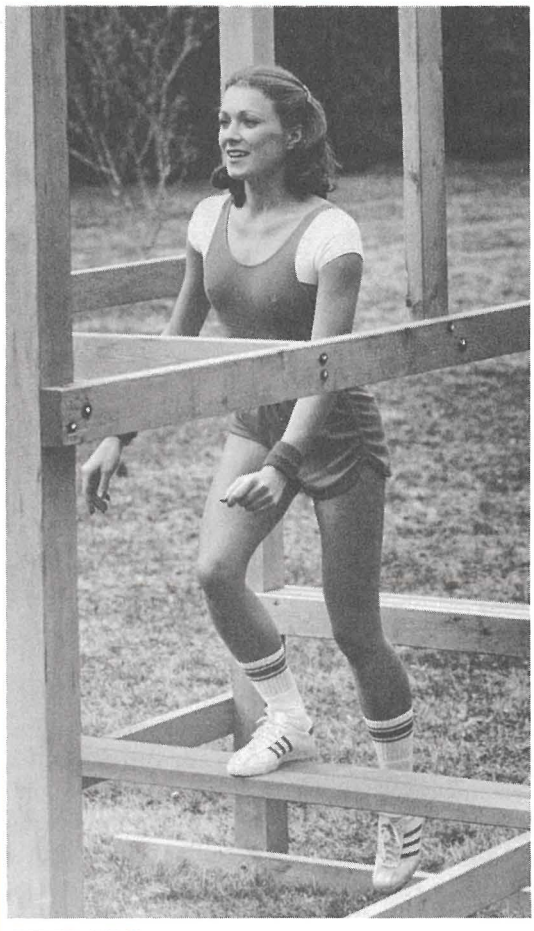
BACK ARCHES

YOUR LOWER BACK sacrospinalis muscle is exercised by arching. Lie across platform at rear of the structure, hooking one or both feet under the step. Raise and lower your trunk (but only if you have no lower back problems). A folded towel may be used for cushioning. Repeat a few times.



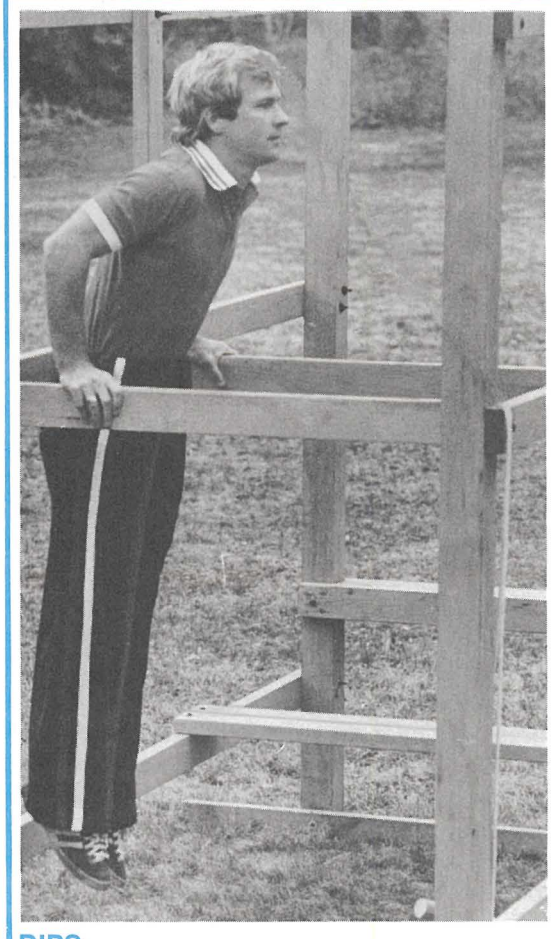
PUSH-UPS

THE PECTORALIS major muscles of your chest are exercised by pushing your arms away from your body. Push-ups will keep chest muscles firm. With feet on the ground, place hands on stepping bench at shoulder width and assume push-up position. Raise and lower your body as often as you can comfortably.



STEP-UPS

BENCH STEPPING works out your buttock gluteus maximus and front thigh quadriceps muscles. Step up onto the bench with your right foot, then step down. Repeat 10 times with each foot.



DIPS

DIPS strengthen triceps muscles that straighten your arms. Put a hand on each parallel bar, keeping arms straight. Lower yourself slowly until shoulders almost touch your hands, then push back up.

Four smashing ideas for bedrooms

Noted interior decorator Ann Heller has put together some concepts and come up with four bedrooms full of great ideas. We show you here how to build them inexpensively using common materials

By HARRY WICKS

1

YOU DON'T have to spend a fortune to improve the looks and function of the bedrooms in your home. Using easy-to-work-with plywood, we created four rooms loaded with ideas that you can duplicate.

The teen-age girl's room with its contemporary four-poster is sure to delight your daughter. To keep a boy happy, we've developed a trundle bed system that lets him squirrel away his treasures whenever the urge strikes him. For Mom and Dad there's an elegant headboard with carpet-wrapped posts and convenient shelf for telephone, radio, TV or the like. We've also created an arrangement that quickly converts your den to a bedroom for guests.

To keep down costs, all projects are built using plywood and pine. Since most parts are then covered with either self-adhesive plastic wallcovering or carpeting, you can work with low cost C-D plywood, if desired, to keep down costs.

final assembly in room

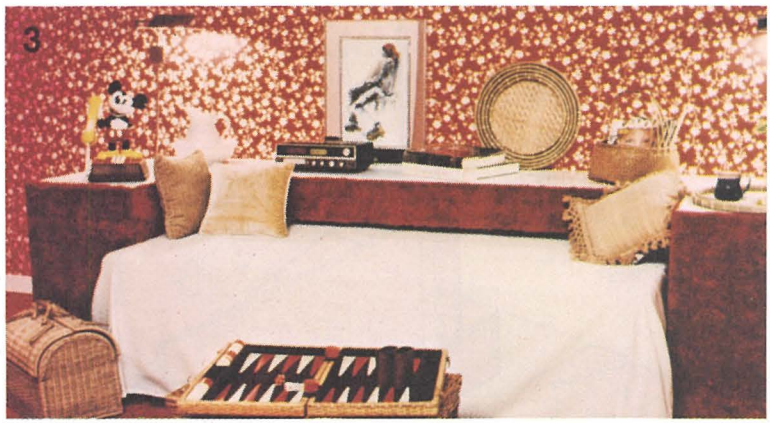
Due to its large size, the four-poster bed is created in modular form to permit easy, in-the-room final assembly. The bottom frame is too bulky to move when assembled, which means you should plan to join these parts in the room where the bed will remain.

Remember, the four posts should be dimensioned to ceiling height—so measure your room before cutting the plywood for the posts. Ceilings are rarely perfectly level, so you might be wise to allow an extra inch or two between the top of the posts and the ceiling. Note that the posts are ⅜-in. shy of touching the bottom platform: This allows clearance for the carpeting on the bed's platform.

Once the bed is assembled, finish by covering it with a print in the self-adhesive wallcovering collection to suit your room decor.

Master bedroom: If desired, lumber cost for

1 **ELEGANT** four-poster (opposite) is sure to appeal to teenager.
2 **EASY CLEANUP** was the aim when we designed the room above and to the left.
3 **DEN-GUEST** room shows that sometimes it can pay to be in the red.
4 **PUTTING** a queen-size bed in a pint-size room took some doing. The headboard is both pleasing and functional.



this project can be held down by buying a 2×8-ft. ½-in.-plywood panel for the posts and a 4×6-ft. panel for the backboard. This will cost about $25. For easier nailing when assembling, glue and nail the blocks D to the inside members F before joining the posts to the center rectangle.

Trundle bed: Use a straightedge guide and portable circular saw to cut all pieces to size. Glue and nail the back to the sides, then add the top and bottom. Attach the continuous hinge to the top edge and to the lid face. Add support block G at center as shown. Our bed is finished by covering all exposed surfaces with carpeting to match the floor. Check carpet thickness and

make certain that lattice surround I is wide enough to hide carpet edges fully. If necessary, buy wider lattice.

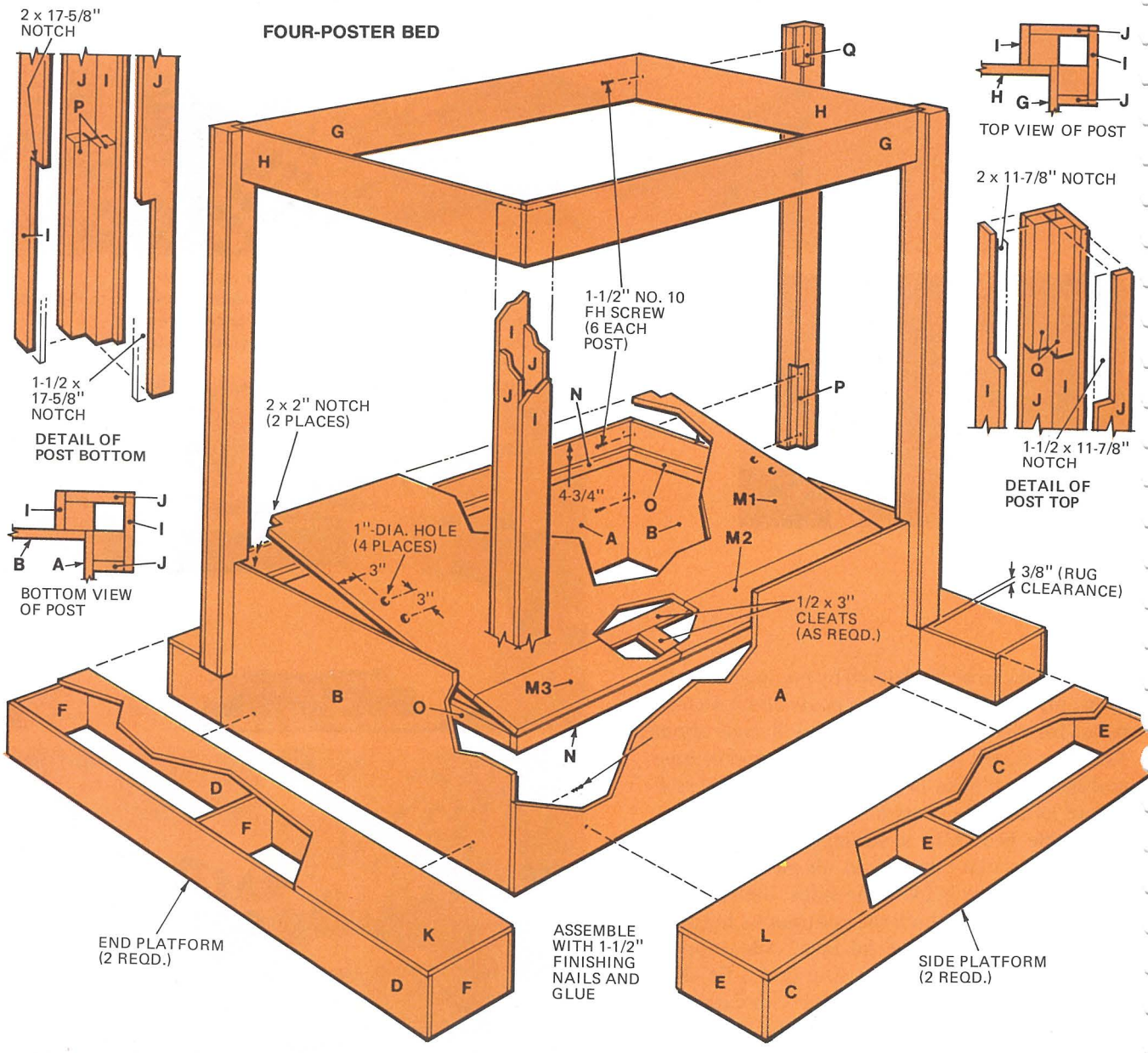
Cube: Cut the plywood parts for the cube and assemble with glue and nails. Ease all corners with a plane, sand smooth, prime and paint.

Guest room: This setup consists, basically, of two cubes with a platform (shelf) between them. Assemble parts as shown and finish by covering the exposed vertical surfaces with carpeting. Carpeting can be joined to plywood using staples, double-faced tape or both. Quality carpet tapes are available at floor-covering and hardware stores.

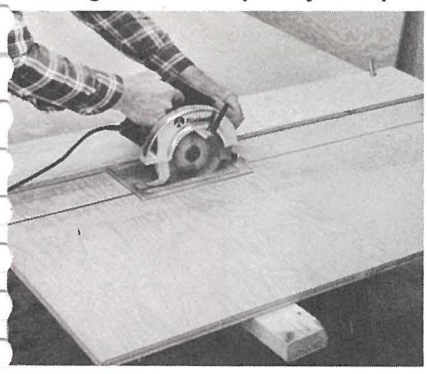
MATERIALS LIST—FOUR-POSTER BED

Key	Pcs.	Size and description
A	2	½ × 26 × 77½" A-D plywood
B	2	½ × 26 × 55½" A-D plywood
C	4	½ × 7½ × 77½" A-D plywood
D	4	½ × 7½ × 84" A-D plywood
E	6	½ × 7½ × 12¾" A-D plywood
F	6	½ × 7½ × 12¼" A-D plywood
G	2	½ × 11⅞ × 77½" A-D plywood
H	2	½ × 11⅞ × 55½ A-D plywood
I	8	½ × 4 × 87⅝" A-D plywood
J	8	½ × 3 × 87⅝" A-D plywood
K	2	½ × 13¼ × 84" A-D plywood
L	2	½ × 13¾ × 77½" A-D plywood
M		¾ × 55¼ × 76¼" A-D plywood
M1		48 × 76¼"
M2		7¼ × 48"
M3		7¼ × 28¼"
N	2	¾ × 1½ × 76½" pine
O	2	¾ × 1½ × 54" pine
P	8	1½ × 1½ × 18" pine
Q	8	1½ × 1½ × 12" pine

Misc.: ½ × 3" plywood cleats (as regd.), 24 1½ No. 10 fh screws, 8 1" No. 10 fh screws, 1½" finishing nails, glue


FOUR-POSTER BED
2 x 17-5/8" NOTCH
1-1/2 x 17-5/8" NOTCH
DETAIL OF POST BOTTOM
BOTTOM VIEW OF POST
TOP VIEW OF POST
2 x 11-7/8" NOTCH
1-1/2 x 11-7/8" NOTCH
DETAIL OF POST TOP
1-1/2" NO. 10 FH SCREW (6 EACH POST)
2 x 2" NOTCH (2 PLACES)
1"-DIA. HOLE (4 PLACES)
3"
3"
4-3/4"
1/2 x 3" CLEATS (AS REQD.)
3/8" (RUG CLEARANCE)
END PLATFORM (2 REQD.)
ASSEMBLE WITH 1-1/2" FINISHING NAILS AND GLUE
SIDE PLATFORM (2 REQD.)

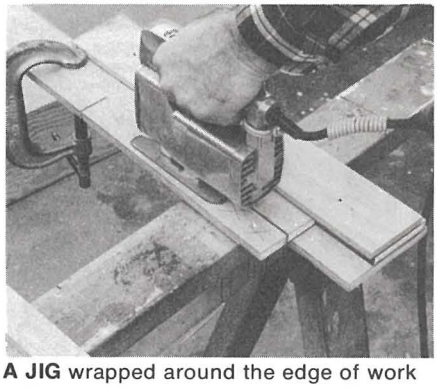
Building the contemporary four-poster



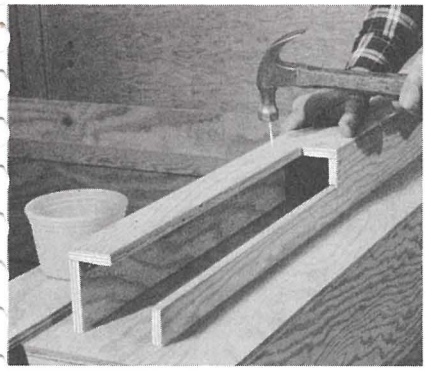
PRECISION crosscuts are made with a clamped straightedge. Panels are supported by three 2×4s on sawhorses.

CLAMPS are handy for holding boards while nailing. A temporary centerpiece permits lifting ends to apply glue.

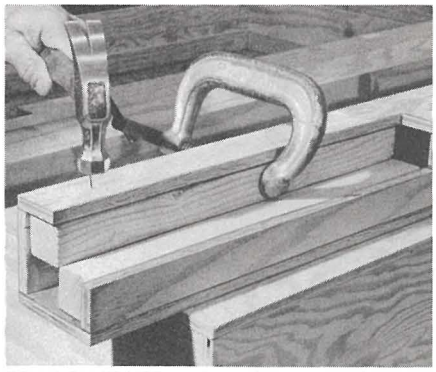
AFTER GLUING up rectangle, tack temporary braces in corners to hold it square while the glue sets overnight.



A JIG wrapped around the edge of work guides sabre saw for vertical notch cut. This works better than the saw's guide.

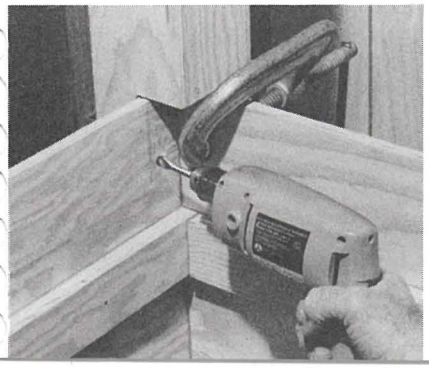


ASSEMBLE NOTCHED posts with glue and nails. Notch width varies ½ in. between the 3½- and 4-in.-wide strips.

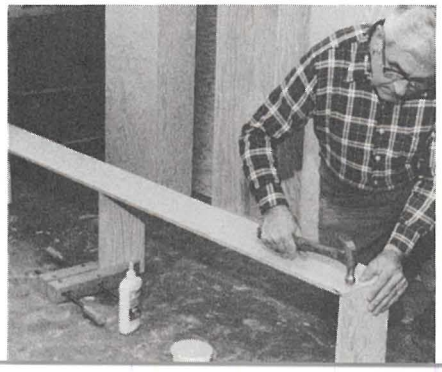


TO FACILITATE nailing of the post pieces, clamp a filler block as shown. Set nails and fill depressions with wood filler.

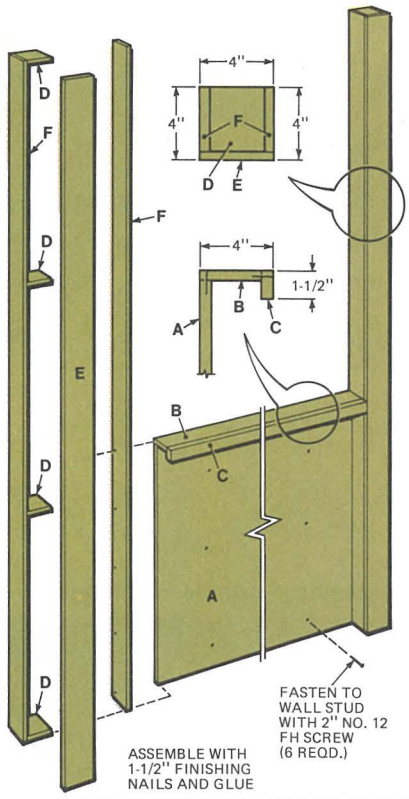
POST SHOULD be held securely in place—a C-clamp is being used here—while you bore pilot holes for screws.



PLATFORMS are made up as individual units, then secured to the bed frame with nails or screws during final assembly.



MASTER BEDROOM HEADBOARD



MATERIALS LIST—MASTER BEDROOM

Key	Pcs.	Size and description
A	1	½ × 36 × 60½" A-D plywood
B	1	½ × 3¼ × 60½" A-D plywood
C	1	¾ × 1½ × 60½" pine
D	8	¾ × 3 × 3½" pine
E	2	½ × 4 × 96" A-D plywood
F	4	½ × 3½ × 96" A-D plywood

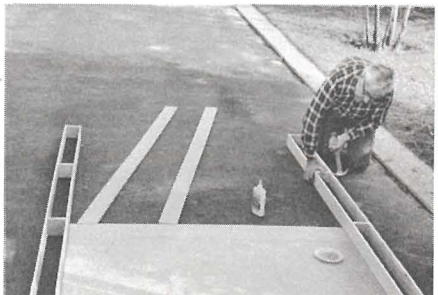
Misc.: 1½" finishing nails, glue, 6 No. 12 × 2" fh screws

bedroom ideas, continued

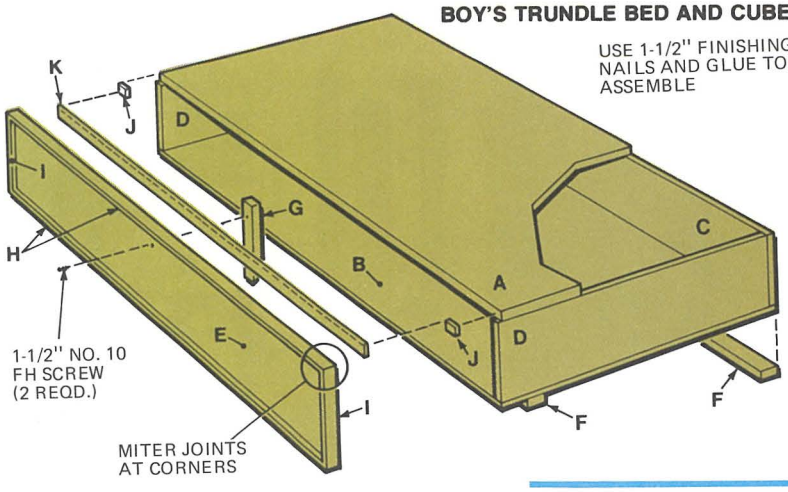
Building the headboard

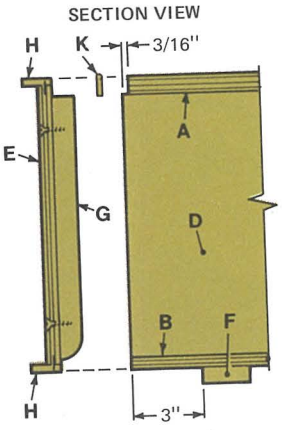
FOR EASIER hammering, fasten blocks D to inside strips before nailing to backboard.

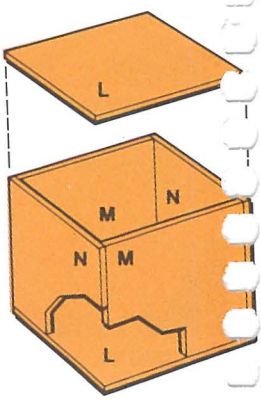
NEXT, glue and nail the outer strips and then add the front pieces.



BOY'S TRUNDLE BED AND CUBE







MATERIALS LIST—TRUNDLE BED

Key	Pcs.	Size and description
A	1	¾ × 38⁹/₁₆ × 75" A-D plywood
B	1	½ × 38½ × 75" A-D plywood
C	1	½ × 10¾ × 75" A-D plywood
D	2	½ × 10¾ × 38" A-D plywood
E	1	½ × 11½ × 74½" A-D plywood
F	2	¾ × 2 × 75" A-D plywood
G	1	1½ × 1½ × 10¾" pine
H	2	¼ × 1¼ × 75" lattice
I	2	¼ × 1¼ × 12" lattice
J	2	³/₁₆ × ¾ × 1½" pine
K	1	1½ × 72" continuous hinge

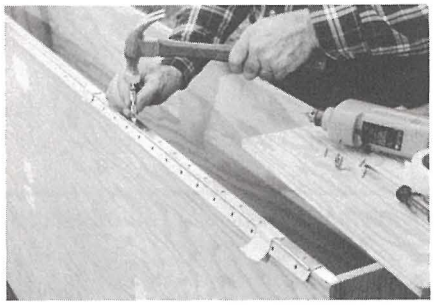
Misc.: 1½" finishing nails, glue, pull (optional)

CUBE

Key	Pcs.	Size and description
L	2	½ × 16 × 16" A-D plywood
M	2	½ × 15 × 16" A-D plywood
N	2	½ × 15 × 15" A-D plywood

Misc.: 1½" finishing nails, glue

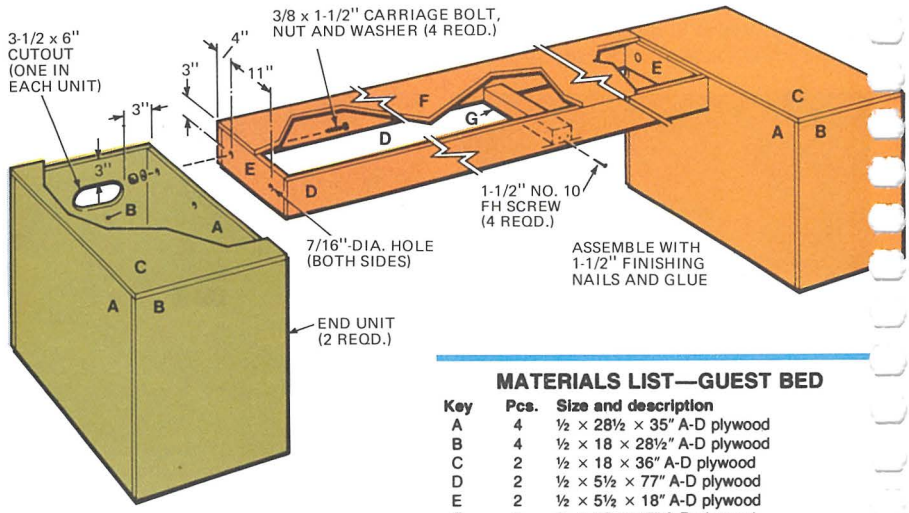
Fastening a trundle bed hinge



HOLD HINGE in place with masking tape while you mark locations for screw holes. A self-centering punch works best.

SUPPORT BLOCK G with rounded lead edge fits snugly between the top and bottom edges to keep top from sagging.

DUAL-PURPOSE GUEST BED


3-1/2 x 6" CUTOUT (ONE IN EACH UNIT)
3/8 x 1-1/2" CARRIAGE BOLT, NUT AND WASHER (4 REQD.)
4"
3"
11"
3"
3"
1-1/2" NO. 10 FH SCREW (4 REQD.)
7/16"-DIA. HOLE (BOTH SIDES)
ASSEMBLE WITH 1-1/2" FINISHING NAILS AND GLUE
END UNIT (2 REQD.)

MATERIALS LIST—GUEST BED

Key	Pcs.	Size and description
A	4	½ × 28½ × 35" A-D plywood
B	4	½ × 18 × 28½" A-D plywood
C	2	½ × 18 × 36" A-D plywood
D	2	½ × 5½ × 77" A-D plywood
E	2	½ × 5½ × 18" A-D plywood
F	1	½ × 19 × 77" A-D plywood
G	1	1½ × 2½ × 18" fir

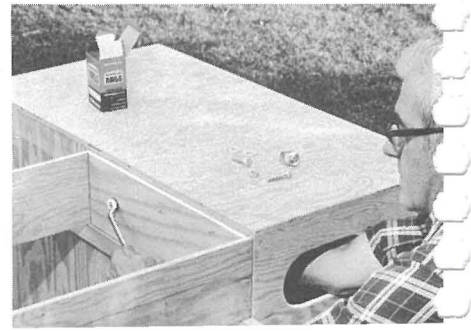
Misc.: (4 ea.) 1½ × ⅜" carriage bolt, washer, nut; 1½" finishing nails, glue

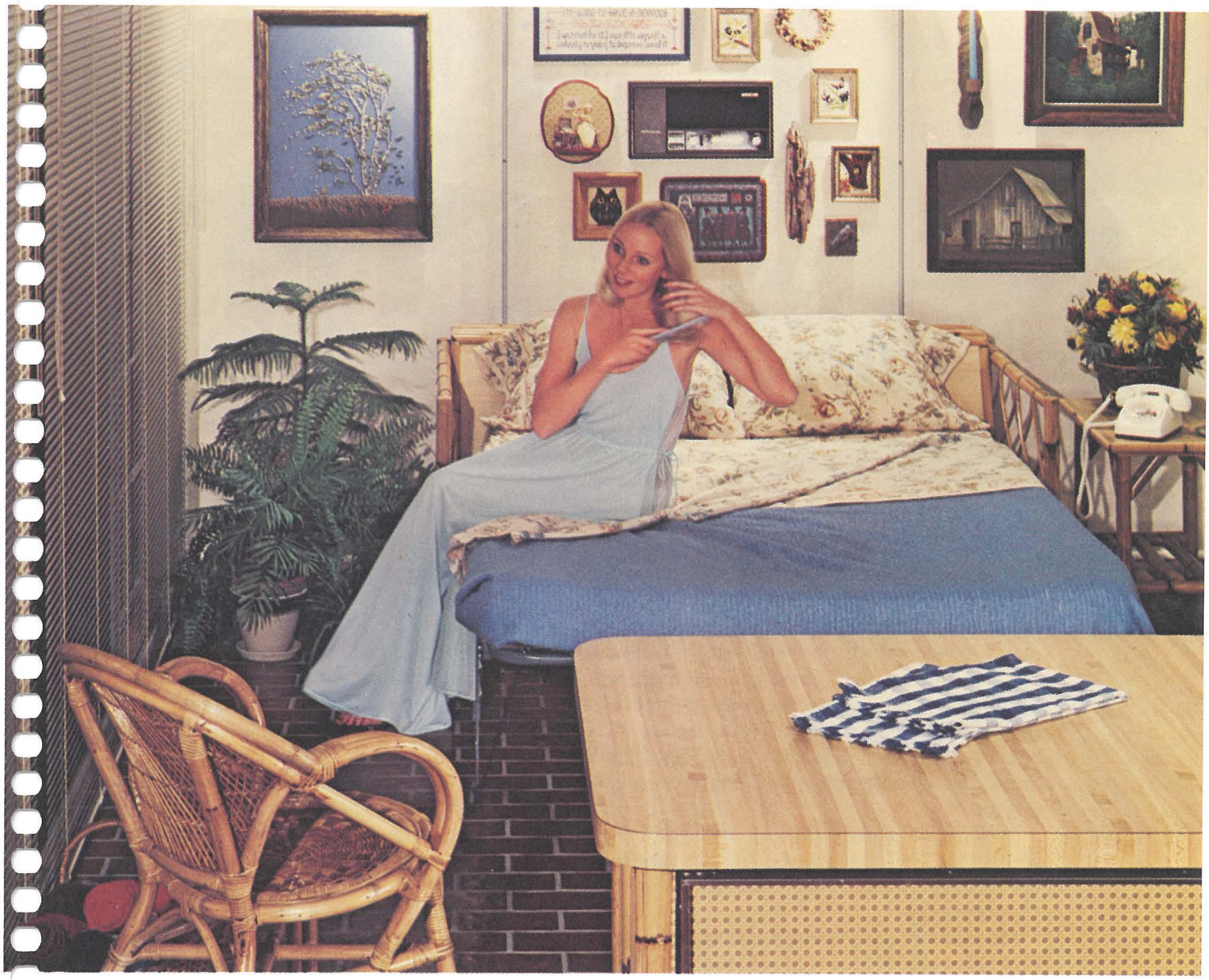
Assembling the guest-bed components

ASSEMBLE the end cubes; then, using a sabre saw, cut access holes in rear.

USE A temporary cleat to support the center rectangle while boring holes.

ACCESS HOLES make it easy to attach the connecting bolts. The top is glued later.





From porch to family room

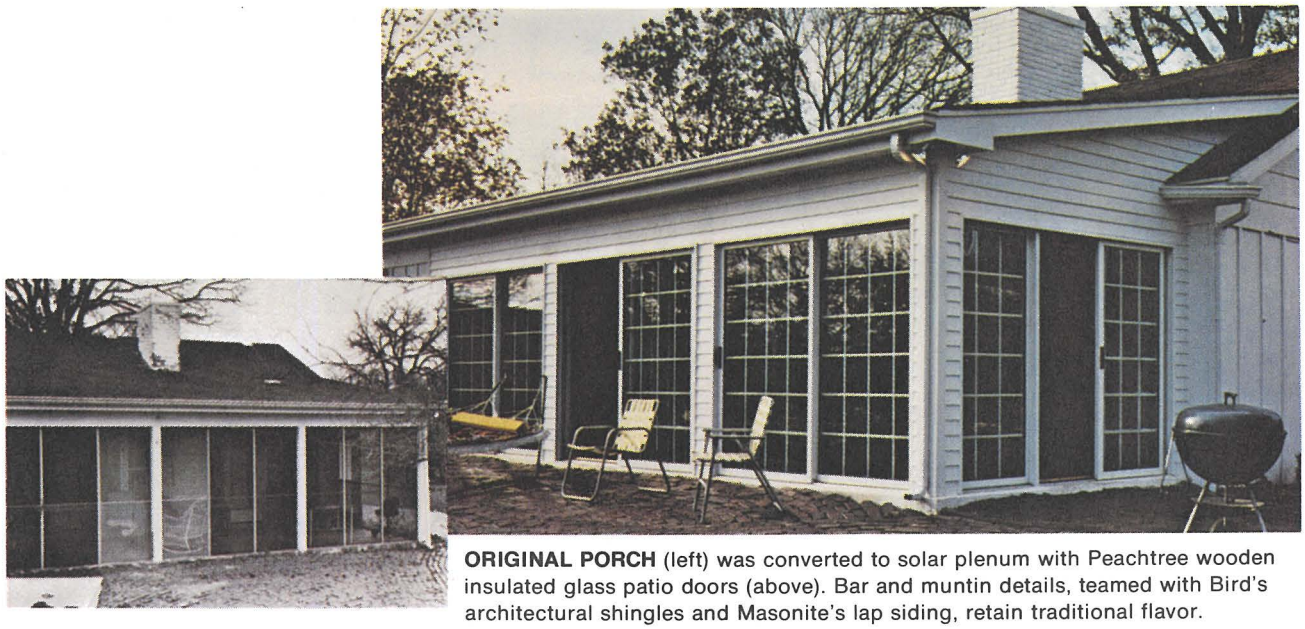
This home improvement project uses a number of tricks to squeeze as much heat as possible out of the winter sun, yet minimizes excess heat gain during the summer months

By DAVID WARREN

■ THE SUN—whether you own a solar house or not—has an influence on your space-heating requirements. Maximizing the potential for solar heat gain in winter and minimizing it in summer can bring annual savings in your energy bills. This PM home improvement is full of energy conservation ideas.

The inspiration for my application of solar energy came by simply observing existing conditions and being receptive to possibilities. For example, at the end of each summer season for several years, I have tacked Visqueen plastic over our porch screens to keep out spring and fall driving rains and midwinter snow drifts.

I noticed a marked greenhouse effect in the porch on cold but sunny days. The porch was usually 20° or 25° warmer than the outside. Unintentionally I had created a passive solar energy system that reduced the heat loss of adjacent living areas.



ORIGINAL PORCH (left) was converted to solar plenum with Peachtree wooden insulated glass patio doors (above). Bar and muntin details, teamed with Bird's architectural shingles and Masonite's lap siding, retain traditional flavor.

It occurred to me that if 4-mil plastic was this effective, walls designed specifically for capturing solar energy would be even more so. The plan I developed was to install heavy insulating glass to trap the sun's rays, add a dark floor to absorb those rays, and insulate the perimeter of the slab and the ceiling to retain the captured heat. To go one step farther, I decided I could draw that warmth into the living areas of the house.

To assure a daily return on my solar investment, I decided to make the porch a handsome family room giving us additional attractive, comfortable living.

The room is designed for easy maintenance. Masonite Casa Blanca wall paneling has a tough finish that needs only occasional wiping. Sliding-door grilles (muntins) can be removed quickly for easy window cleaning, the Jenn-Air range ventilating system keeps the ceiling clean, and Nevamar plastic laminate on the peninsula food-preparation center requires little maintenance. Wooden furnishings wouldn't stand up in a solar plenum. We chose rattan, which has the warmth of wood furniture but is more durable in sunlight.

A dark floor was desirable because it had to serve as a heat bank. Black was out because it shows dust too quickly. We opted for American Olean's Primitive 865 walnut floor tiles.

To use the porch on cloudy winter days, it was necessary to install supplementary heat.

We settled on a modern heat pump. It provides fan-blown warm air efficiently. Its efficiency varies according to temperature zones, but is in keeping with the solar/energy saving direction wanted.

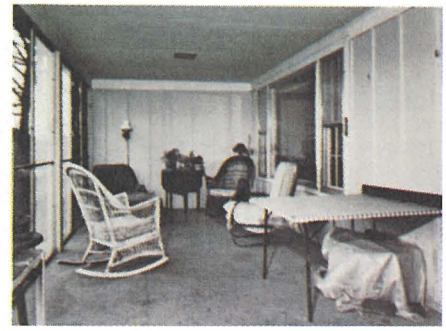
Compared with normal electric resistance heating, the heat pump will save energy dollars. The solar assist for the heat pump by our family room should yield another 10 percent reduction in our space-heating fuel costs.

Get started by carefully planning all details of your design by preparing ½-in.-scale sketches. Use your plans to prepare a bill of materials, check prices and get bids from professionals for any work to be contracted.

The first thing we did was to remove light fixtures and the plywood ceiling. Then wiring was roughed-in for the lights, security, vent and intercom systems. The 240-volt wiring for the grill and heat pump required an electrician.

To insulate the solar heat sink, we excavated along the foundation walls of the porch to below the frost line and installed two 1½-in. layers of Stryofoam. The sheets were propped with boards until we were ready to backfill. For appearance and protection, we applied a thick mixture of Thoroseal and Acryl-60 latex, obtained from a cement contractor supplier, to the exposed surfaces of the rigid insulation.

Next we laid out the door openings so that the vertical spaces between them (and at corners) were all of equal width. After assembling the door frames supplied by the manufacturer, the rough openings were framed to suit the overall door-frame dimensions, allowing a ¼-in. space at top and sides.



BEFORE VIEW (right) was replaced by the beautiful one above. The studio couch converts to a bed for guests. A peninsula unit in the middle of the room features grill, ceramic cooktop, undercounter refrigerator, and built-in food center.

The siding was applied after sheathing and exterior door trim were up. To achieve a traditional clapboard appearance, 6-in.-wide Masonite siding was lapped 2 in. (the maximum recommended), leaving 4 in. exposed to the weather. Ringed siding nails were used to fasten siding every 16 in.

To begin, we made a starter strip by ripping a piece of lap siding 2 in. wide and nailing it level along bottom edge of sheathing. Then the first course of siding was nailed ⅛ in. below starter strip. Joints were butted at stud locations only and staggered so they didn't fall on the same vertical line.

Quarter-round molding was installed at the siding-eave joints. Joints where siding meets door trim were caulked and the exterior received two coats of paint.

Turning our attention to the inside, the heat pump, along with its wiring and duct work, was installed. Designing the air-handling system and installing the components are jobs for professionals.

After the duct work was completed, 10-in. (R-30) fiberglass batts were stapled between the ceiling joists with the Kraft paper facing the living space; 4-in. fiberglass batts were fastened to the wall above and between the doors. Canned foam insulation was used in crevices.

The wall paneling we chose (Masonite's Casa Blanca) simulates rough plaster and is installed with white nails. We minimized exposed joints by locating architectural features to coincide with them. For example, the vertical track lighting fixtures at the end wall conceal two major vertical joints. The remaining wall and corner joints were hidden by applying latex caulk to the crevices and spreading it in a pattern similar to the adjoining panels. Afterward, the patch was blended to the wall surface with latex paint.

To prepare for installing the ceiling tiles, we nailed 1×3 furring strips to the ceiling joists, 12 in. on center, since our tiles (Armstrong's Olde Hickory) were 12 in. wide. Stapling flanges for fastening tiles to the furring strips were provided.

For the floor we wanted the real feel and durability of ceramic. Undertake only as much tile laying or grouting as you have time to complete in one session.

Thinset-type cement was carefully selected as having the best heat-conducting properties to transfer solar heat to the cement slab heat sink. We used H.B. Fuller's Lifetime Cement and Fuller's Sand Beige Joint Filler (grout) with 868 additive.

To start the tiling installation, snap a chalkline grid (24-in. squares) on the concrete floor. Each tile was inspected before laying to be certain it wasn't chipped.

The running bond pattern we used calls for half tiles to start every other row along the sliding-glass-door wall. Our tile supplier rented us a tile cutter for the job. The half tiles were cut from the few flawed tiles we found in some of the boxes.

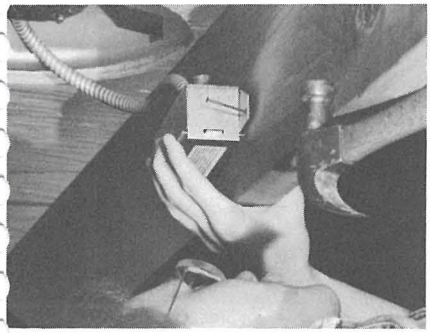
Starting in a corner of the porch, we used a

BLINDS CONTROL amount of sunlight admitted—they can be tilted to direct sun to dark tiles which serve as a heat bank. Warm air is then ducted from the porch to the heat pump. The room also features a ducted Jenn-Air range in the peninsula. Dining area is separated from living/sleeping area by the peninsula unit. Open room increases the feeling of spaciousness.

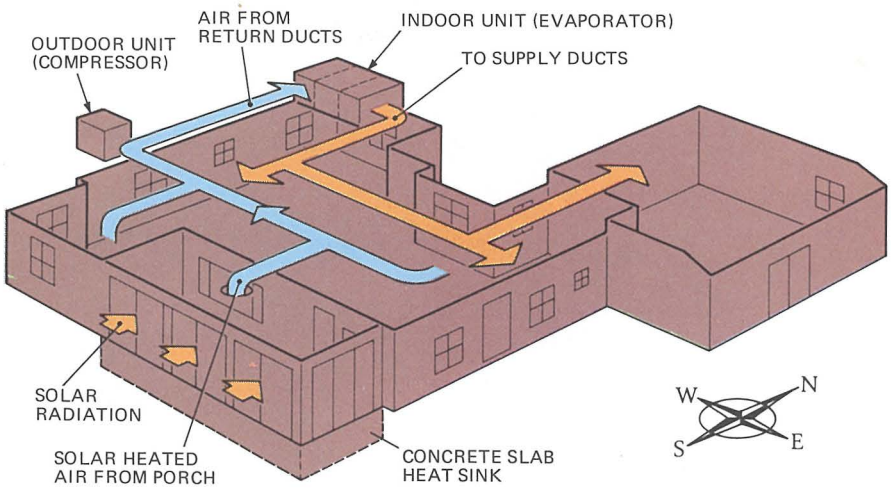
⅜-in. notched trowel to spread cement evenly in the first chalklined grid. Half and full tiles were placed on the cement and pressed down firmly so no dead air space remained between tile and floor. The cement bond was about ⅛ in. thick. Open joints between tiles were ⅜ in. apart.

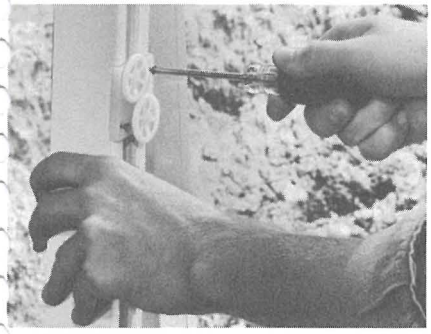
After the completed floor dried 24 hours so it could be walked on, grout was prepared and spread in the open joints. To do this, use a rubber-faced float that won't scratch the tile surfaces.

Installation of the blinds completes the construction. The blinds block the sunlight on summer days, insulate windows on winter nights, and provide privacy at any time desired. We chose Levolor Riviera Blinds with 1-in. slats in Eggshell Satin (142).



1 POWERED ROOF vent in attic exhausts any summer heat buildup and reduces the heat pump cooling load.





2 INSULATED glass patio doors can be installed to slide left or right depending on the roller placement.

3 INSIDE SCREENS stay cleaner than conventional screens, and are easily removed in winter to let in solar heat.

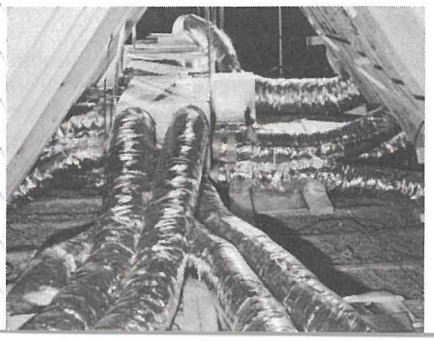
4 URETHANE FOAM from can insulates the crevice around the sliding doors prior to installing paneling on the walls.

5 RIGID FOAM around foundation and heat sink (existing slab) reduces heat loss at building perimeter.

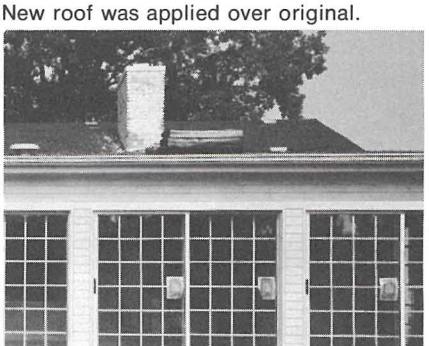
6 TO SEAL cracks and protect exposed surfaces of rigid insulation, apply Thoroseal mixed with Acryl-60.

7 FIBERGLASS batts, kraft-backed side down, are stapled between ceiling joists following electrical and duct work.

8 INSULATED air-handling ducts transfer solar heat to the heat pump and to rooms on the north side of the house.



9 VERTICAL WALL sections between door units should all be the same width. New roof was applied over original.



10 INSTALLING blind headrails on face of door casing allows blinds to clear the door pulls without snagging.

Smart fixes for bathroom problems

By PENELOPE ANGELL

Privacy wall has display ledges

THE TWO-LEVEL privacy wall at one end of the bathtub ca... display greenery or keep bath items close at hand. It's finishe... with cedar planks to match the wall, and topped with a handsome ceramic tile.

Closet-size bath has maxi-space

BEFORE ITS REDO there was no storage space and barely room ... turn around in this tiny half-bath. The designer opened up the area by utilizing Eljer's corner toilet, repositioning the entry and fittin... it with a pocket door that slides out of the way into a wall. The area now accommodates a large vanity and three-way mirror, with bo... offering storage space. Ceramic flooring, improved lighting and venting are finishing touches that add character.

th redo has storage space for all

THE ORIGINAL problems in this bathroom made it a remodeler's ght. The tub prevented the bathroom door from opening mpletely, and storage space was limited. We installed a new tub in a different place and added cabinets over the shower, toilet and in vanity area. A stained glass insert in the partition separating tub/shower and toilet is an elegant detail. The clay tile on the floor surrounding the bathtub provides a handsome, natural finish to complement the cabinets.

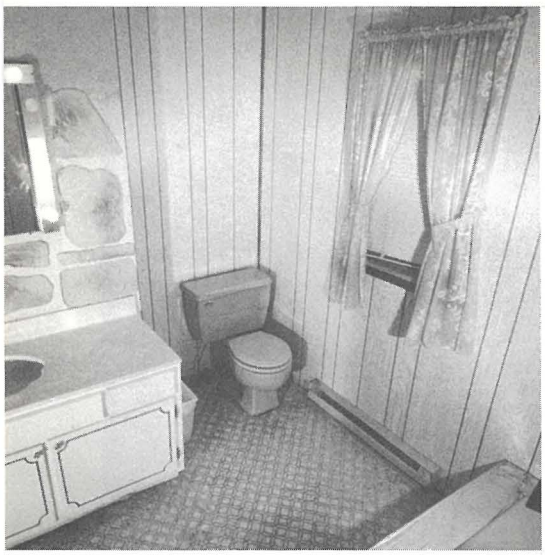
Cabinet clears up bath clutter

THIS 30-in.-wide redwood cabinet adds floor-to-ceiling storage space to a small bathroom and contributes visual interest to the room. The unit is designed to be built with short lengths of lumber and it can be adapted to fit wherever space is available such as over the toilet or vanity (see plans).

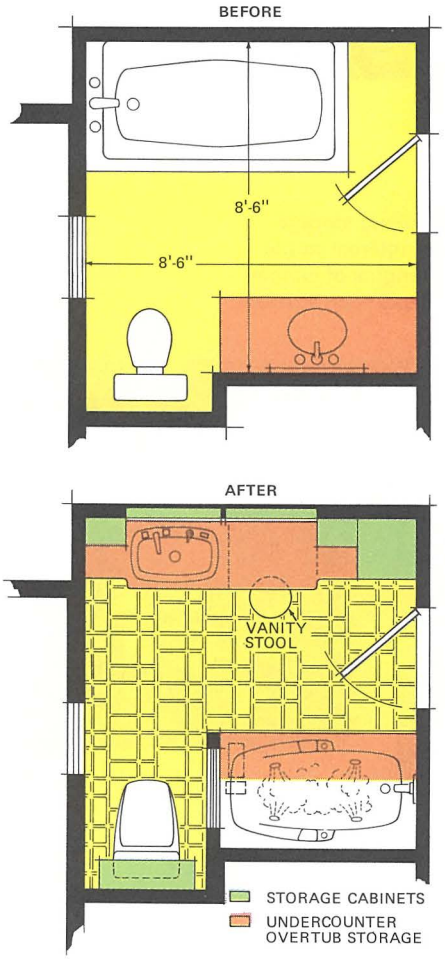
THE BATHROOM may be the one room in your home where convenience the most important feature. Too often, however, bathrooms appear to be poorly planned afterthoughts that fit to leftover space. This is apparent when a family begins to *use* that space. s a reason why bath remodeling is so mmon.

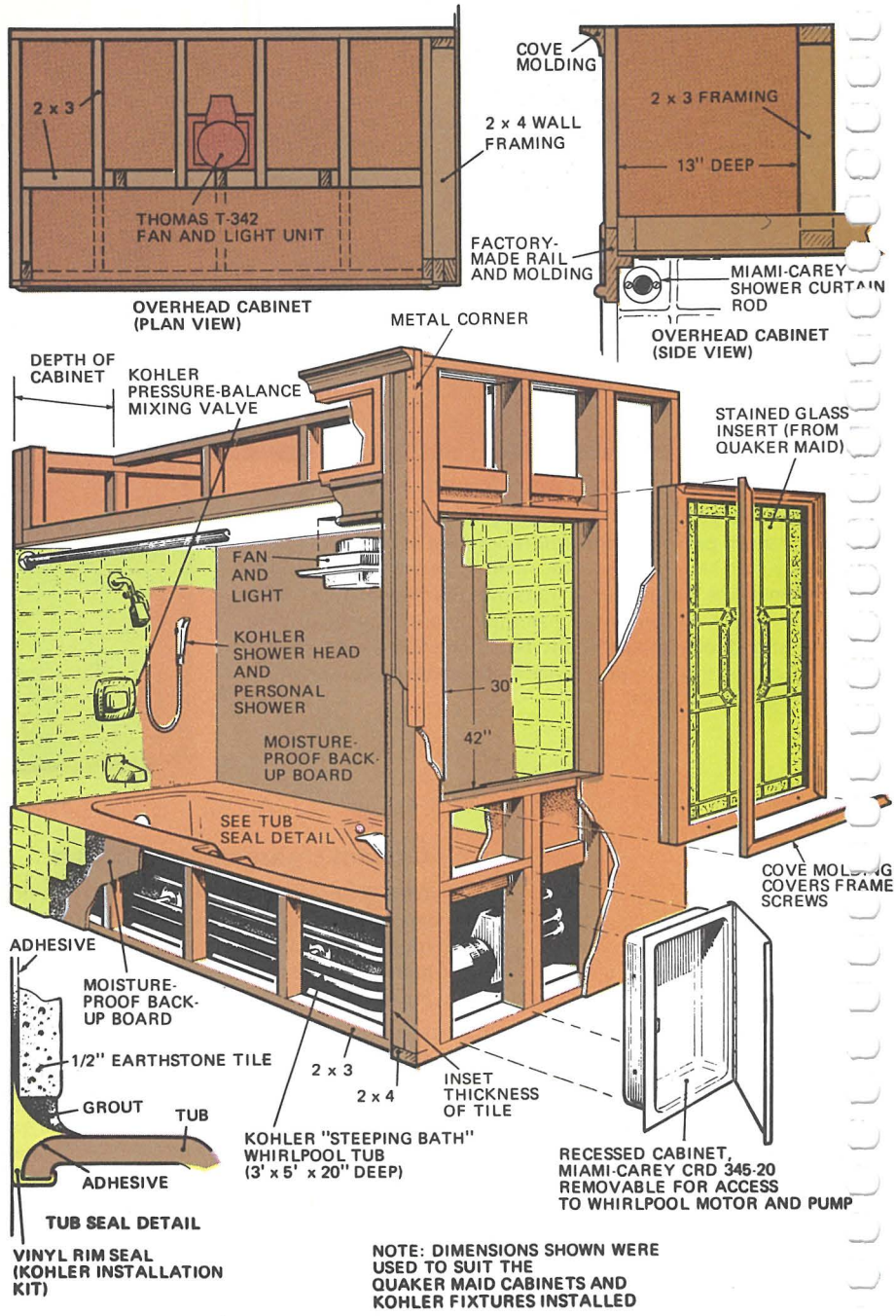
We've selected four bathrooms in rying degrees of need. Each has its own special problem. The problems ay be all too familiar to you.

The remodeled rooms incorporating our solutions are shown on this and the ing page. Design and construction otes and drawings, as well as manufacturer information, are on the following ges, so you can adapt the ideas to your needs.



"BEFORE" photo reveals a bath that has badly mismatched design elements, including incompatible styles and colors.




2 x 3
THOMAS T-342 FAN AND LIGHT UNIT
OVERHEAD CABINET (PLAN VIEW)
COVE MOLDING
2 x 4 WALL FRAMING
2 x 3 FRAMING
13" DEEP
FACTORY-MADE RAIL AND MOLDING
MIAMI-CAREY SHOWER CURTAIN ROD
OVERHEAD CABINET (SIDE VIEW)
METAL CORNER
DEPTH OF CABINET
KOHLER PRESSURE-BALANCE MIXING VALVE
STAINED GLASS INSERT (FROM QUAKER MAID)
FAN AND LIGHT
KOHLER SHOWER HEAD AND PERSONAL SHOWER
30"
42"
MOISTURE-PROOF BACK-UP BOARD
SEE TUB SEAL DETAIL
COVE MOLDING COVERS FRAME SCREWS
ADHESIVE
MOISTURE-PROOF BACK-UP BOARD
1/2" EARTHSTONE TILE
2 x 3
2 x 4
INSET THICKNESS OF TILE
GROUT
TUB
KOHLER "STEEPING BATH" WHIRLPOOL TUB (3' x 5' x 20" DEEP)
RECESSED CABINET, MIAMI-CAREY CRD 345-20 REMOVABLE FOR ACCESS TO WHIRLPOOL MOTOR AND PUMP
ADHESIVE
TUB SEAL DETAIL
VINYL RIM SEAL (KOHLER INSTALLATION KIT)
NOTE: DIMENSIONS SHOWN WERE USED TO SUIT THE QUAKER MAID CABINETS AND KOHLER FIXTURES INSTALLED

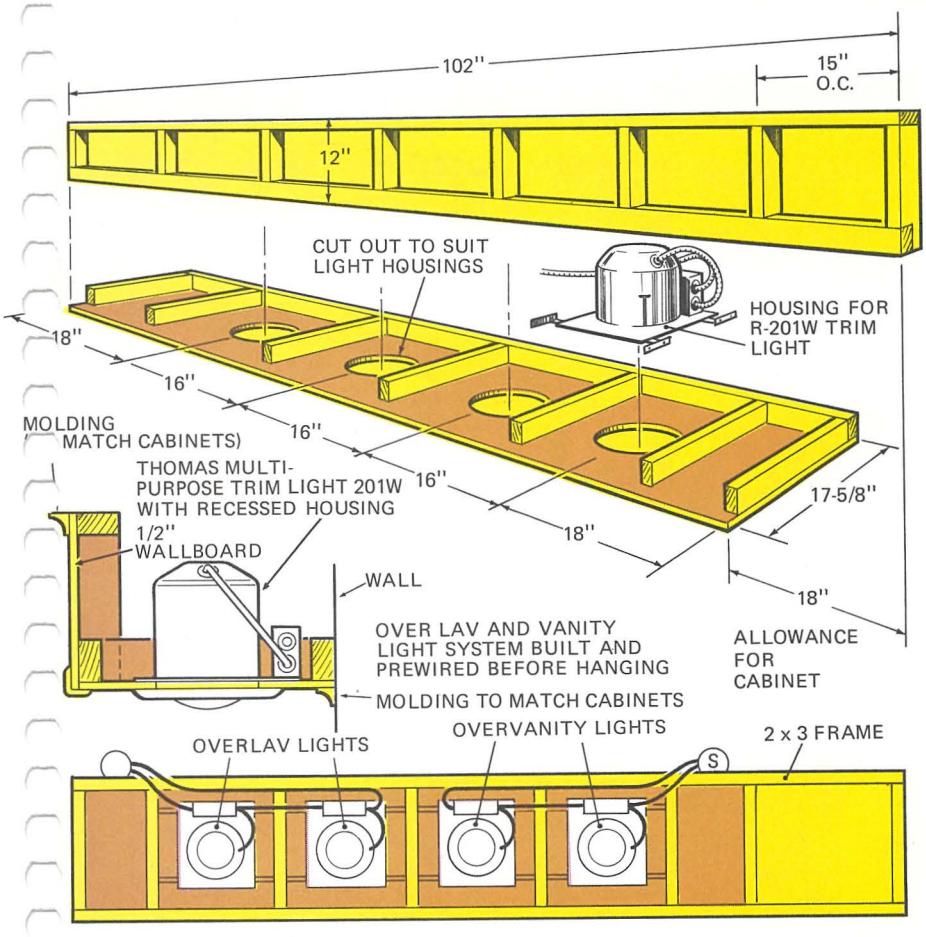
Family-size bath

■ THERE WERE three major problems with this bathroom (see photo above): 1. It didn't have storage space for a large family. 2. The room contained a hodgepodge of furnishings. 3. The floor plan was awkward—the entry door actually bumped into the bathtub each time it was swung all the way open.

We solved the storage problem by using handsome cherry wood cabinetry throughout the space—over the bathtub, over the toilet and in the vanity area. This helped solve the second problem of tying the room together.

In the new floor plan, the bathtub located away from the entry door. We added a whirlpool unit to the tub and pu... a recessed cabinet in the tile enclosur... surrounding the tub. The cabinet can be removed for easy access to the whi... pool motor and pump, if needed. A stor... age cabinet built-in over the tub hold... bathroom supplies.

A wall with a stained glass insert separates the tub from the toilet are... Light shining through a nearby windo...



highlights the stained glass. An over-toilet storage cabinet, with a built-in facial-tissue holder and both open and closed storage areas, can hold toilet tissue and other supplies.

The lavatory-vanity area is located where the tub used to be. A counter which runs the full length of the wall is much narrower than the old tub and allows the entry door to open freely. Plenty of storage space for a large family is provided by wall cabinets, under-counter cabinets and a floor-to-ceiling cabinet in this area. The counter also accommodates a large lavatory and a sit-down vanity area. Instead of the glaring lights of the old bathroom, the new lighting is overhead in the soffit. Lights were prewired before hanging, for easy installation. The soffit molding matches the storage cabinets to give the area a finished appearance. The hardware and decorative lighting has an antique brass finish.

2-level privacy wall

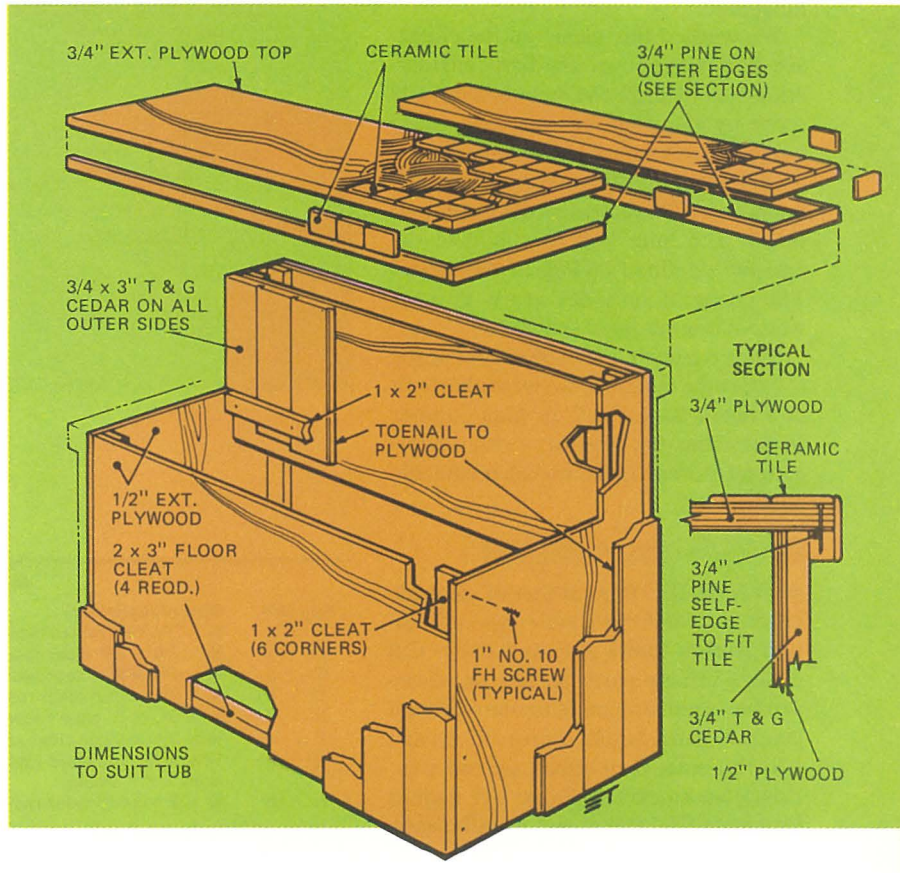
■ THE PRIVACY WALL separates the bathtub from the rest of the room and adds attractive architectural detail. The wall is made of plywood covered with cedar boards.

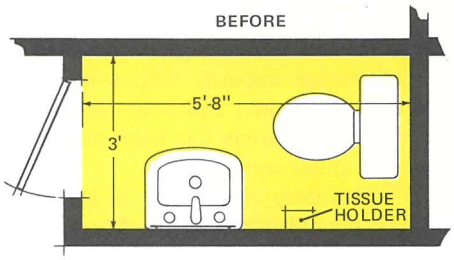
Begin work by cutting and fastening the floor cleats in place. Cut and fasten the vertical 1×2s to the plywood sides with 1-in., No. 10 flathead screws. Then join the sides.

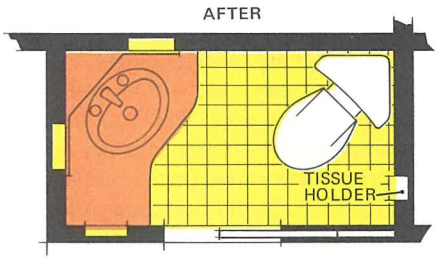
Use resorcinol glue and 1¼-in. finishing nails to fasten the cedar to the plywood. With the sides covered, fasten the 1×2 cleat that supports the back edge of the larger top section.

Cut the plywood tops to size. Cut ¾-in. pine filler strips to form an edging, sized to suit the ceramic tile you plan to use on the tops. Fasten the strips as shown, with resorcinol glue and nails.

Nail the tops to the unit. Then apply ceramic tile, following the manufacturer's instructions.


3/4" EXT. PLYWOOD TOP
CERAMIC TILE
3/4" PINE ON OUTER EDGES (SEE SECTION)
3/4 x 3" T & G CEDAR ON ALL OUTER SIDES
1 x 2" CLEAT
TOENAIL TO PLYWOOD
1/2" EXT. PLYWOOD
2 x 3" FLOOR CLEAT (4 REQD.)
1 x 2" CLEAT (6 CORNERS)
1" NO. 10 FH SCREW (TYPICAL)
DIMENSIONS TO SUIT TUB
TYPICAL SECTION
3/4" PLYWOOD
CERAMIC TILE
3/4" PINE SELF-EDGE TO FIT TILE
3/4" T & G CEDAR
1/2" PLYWOOD





UNDERCOUNTER STORAGE
STORAGE CABINETS

Mini half-bath

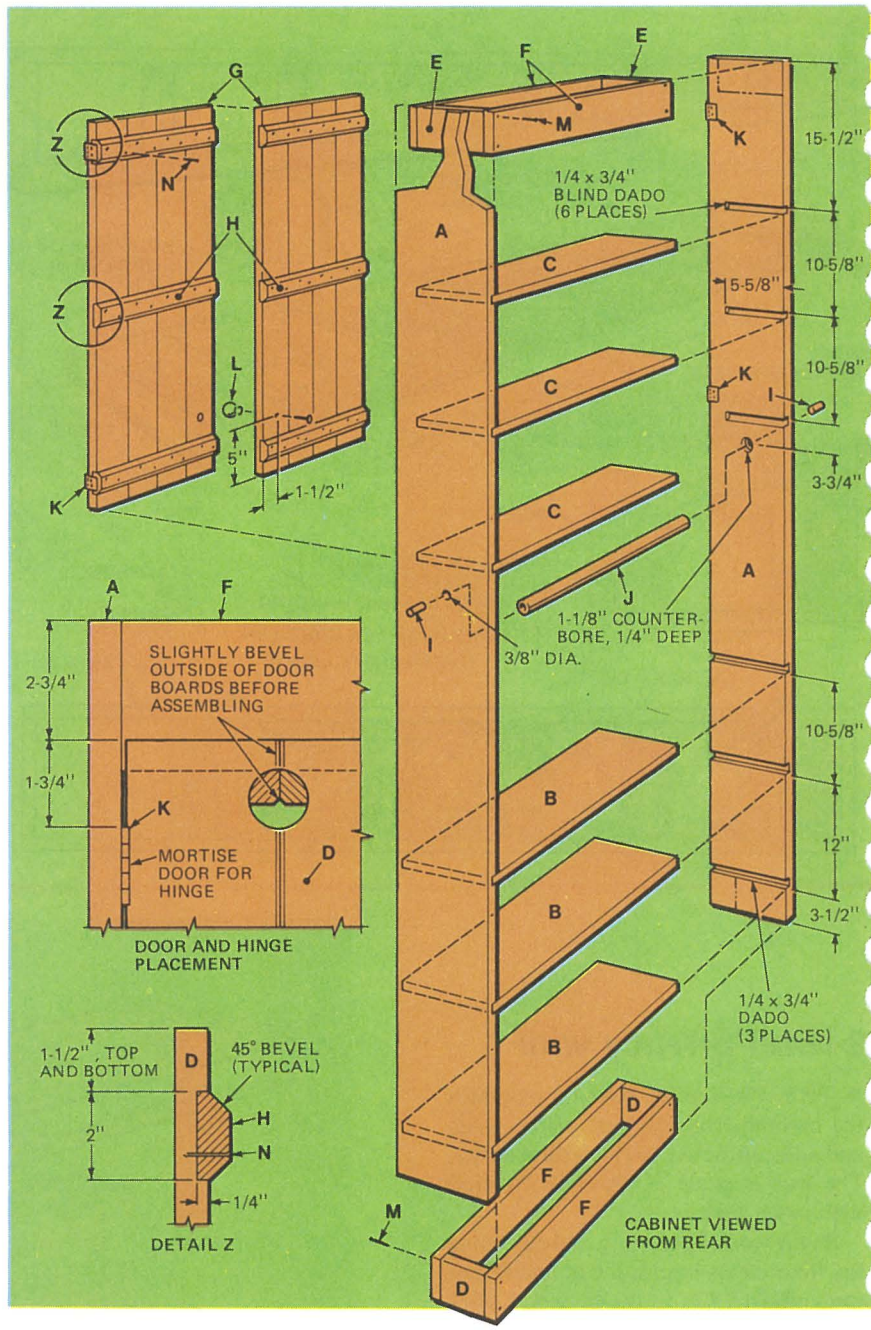
■ MANY HOME remodelers have transformed a little-used closet or space under a staircase to accommodate the bare necessities of a half-bath. But with a little ingenuity and planning, so much more can be done. You can turn that stripped half-bath into one that has plenty of storage space, extra conveniences and a downright luxurious atmosphere.

We worked this magic on the closet-size half-bath above. The first consideration was to make the most of available space by changing the layout. We used corners to advantage by angling the vanity in one and placing a triangular toilet in another. We relocated the door, putting it in a long wall to eliminate the narrow, confined feeling of the space. The pocket door slides neatly into the wall, taking no floor space.

Since we tapped unused corner space to locate the lavatory, we were able to fit in a much larger unit. A wide counter surrounding the lavatory with undercounter storage space was an invaluable addition.

Bathroom cabinet

■ WE BUILT this cabinet of clear all-heart redwood. Assemble top and bottom frames (parts E,F and D,F). Cut dadoes in side parts A, test-fit, disassemble, sand, assemble to one side with glue and nails. Install shelves (C,B) and J to this side, then attach second side. Edge-join stock for doors; cut dadoes for cleats (H). Bevel and install cleats.



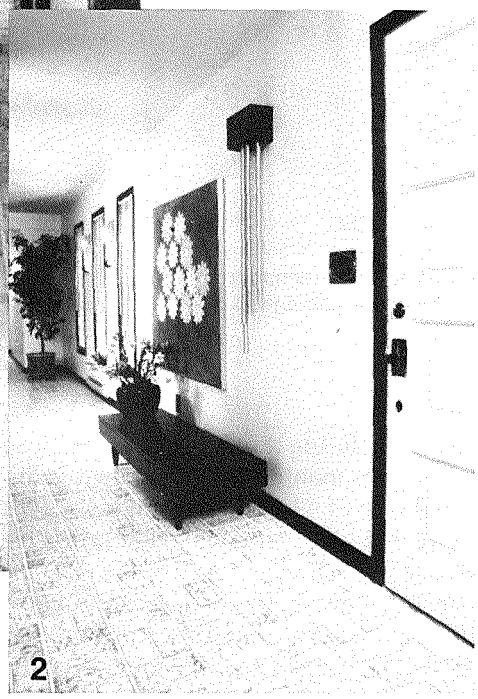
MATERIALS LIST—CABINET

Key	Pcs.	Size (description)
A	2	¾ × 7¼ ×90″ (max.) clear redwood
B	3	¾ × 7¼ × 29″ clear redwood
C	3	¾ × 5⅝ × 29″ clear redwood
D	2	¾ × 3½ × 3½″ clear redwood
E	2	¾ × 3½ × 5″ clear redwood
F	4	¾ × 3½ × 28½″ clear redwood
G	2	14⅛ × 35″ redwood (make up from 1 × 4 stock)
H	6	¾ × 2 × 14⅛″ clear redwood
I	2	⅜″-dia. × 1½″ dowel
J	1	1⅛″-dia. × 29″ round
K	2 pr.	1½ × 2″ brass butt hinge
L	2	1⅜″-dia. ceramic knob (Amerock T727)
M	16	2″ galvanized finishing nails
N	48	1″ brads

Misc.: Resorcinol glue, polyurethane, magnetic catches (optional).

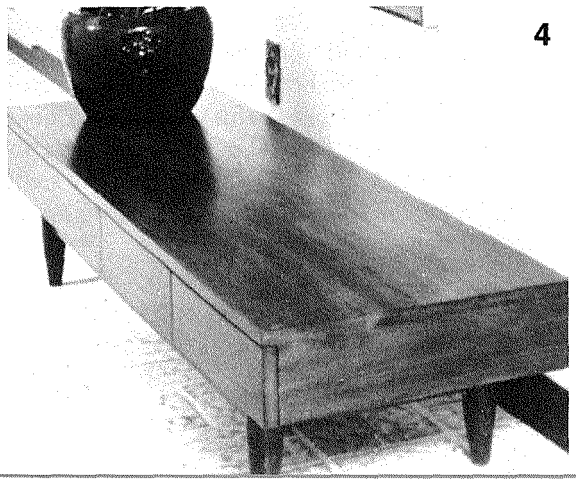
1

LONG ENTRY (1) is brightened and unified by American Olean's Primitive Birch floor tile. Natural textures such as the Townsend walnut wall planks give the area a warm, inviting look. Attention to detail (2)—hardware, art and greenery—produce a smashing view. The table/bench combo (3,4) holds decorative items, stores scarves and makes a handy seat for pulling on boots and rubbers.



2

3



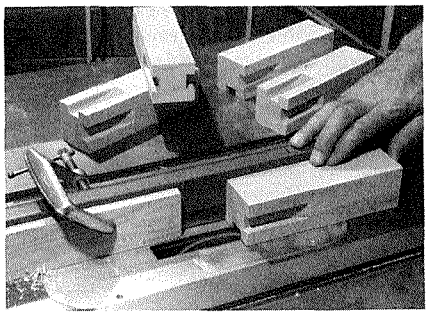
4

An entry that beckons you inside

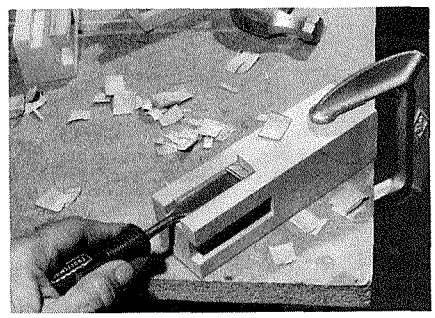
By FRED WOLFF and ROSARIO CAPOTOSTO

FOR THIS PROJECT, we chose a hall entryway in dire need of revision. Originally, the long, dark hall was a hodgepodge of styles, textures and colors.

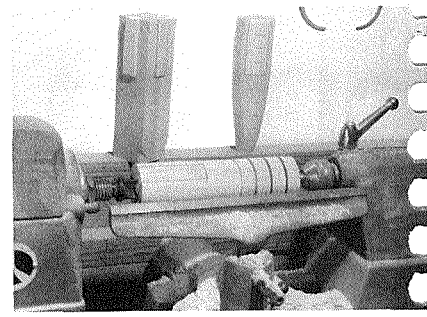
Our first change was to brighten the space with color and light, giving it a clean-line, contemporary look throughout. Windows are covered simply with blinds that bring maximum light into



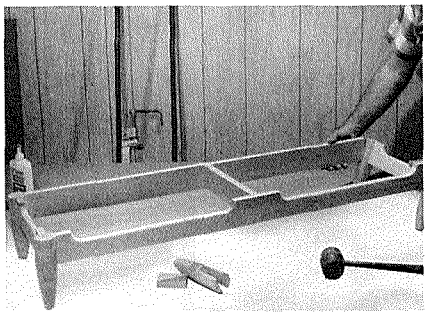
1 CUT MORTISES in leg blocks before turning. Adjust dado head, then clamp a stop block on the fence.



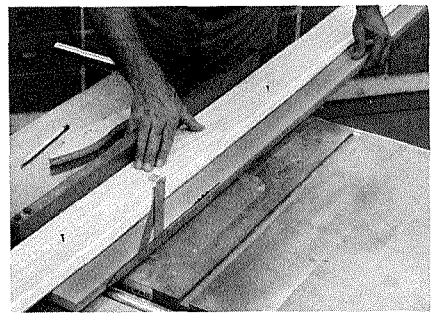
2 CLEAR OUT curved portion of the leg groove with a sharp chisel. Clamp block to table for this step.



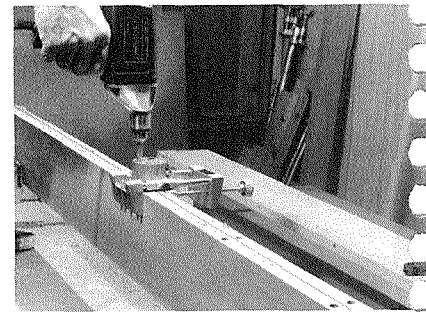
3 TEMPORARILY GLUED blocks prevent splintering at mortise. Parting tool and caliper determine shape.



5 JOIN LEGS to ends, then to front and rear parts. Apply glue sparingly to prevent squeeze-out.



6 UNSURFACED lumber edges are rarely true. Tack-fasten a straightedge to cut the first edge straight.



7 A DOWELING JIG is invaluable when joining boards on edge. Bore mating holes and mark for matching.

the area during the day, or can be closed during the warm months to reduce heat gain.

Choice of white on the window wall, floor and louvered door creates the illusion of greater space than actually exists. Greenery brings a fresh feeling to the long, narrow hall. Natural-looking materials such as ceramic tile and walnut wall planks help give the entry a contemporary look. Simple lighting designs and choice of accessories enhance the effect.

Our multi-purpose foyer table adds to the overall look while storing outdoor needs. We built it of 4/4 poplar (which measured $^{13}/_{16}$ in.), and stained it walnut.

To join the round legs to the square base, square-up turning blocks Q and R, and adjust dado head to make cuts. Note cuts on the fifth leg are different from the first four. Glue filler blocks into the grooves before turning. For easier removal later, insert paper, with a small amount of glue on both sides, between leg and filler block.

Use the gouge to rough-turn the blocks to cylindrical shape. Then make parting cuts to desired depths. Shape with a spear point and skew. Sand the legs, remove filler blocks with a chisel and scrape out the remaining paper.

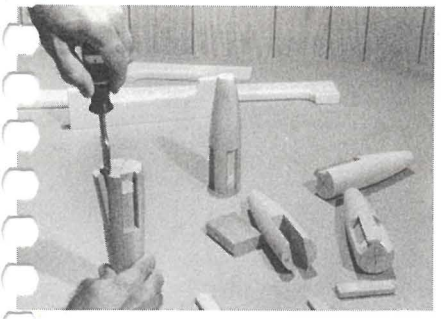
Cut base members E, F, G and H to size. Then run a rounding-over router bit to shape the top edges of F and G. To assemble, first glue two legs into each F piece. Join G and E to H and add the F pieces. Add the fifth leg after you've positioned the bench where it will be used.

Using dowels, edge-glue boards to create A and C. Bore holes accurately using a doweling jig. Glue panels and sand smooth with a belt sander.

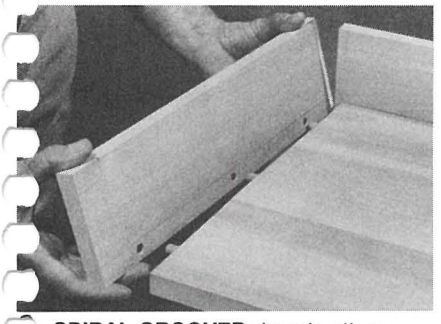
Cut and attach D to C. Cut and add ends B and drawer dividers S. Attach A after C is screwed and glued to legs and drawers are fitted.

Cut front, sides and back for large drawer J, M, N; medium drawer J, K, O; and small drawer J, L and P. Cut grooves for the drawer bottoms in all parts. Assemble sides and back with glue and 4d finishing nails. Cut bottoms T, U and V about $^{1}/_{16}$ in. scant in both directions to avoid expansion problems. Slide bottoms in place and attach drawer fronts N, O and P with glue and 3d finishing nails. Attach drawer-slide hardware and position drawers. Cut faces I and W from the same board for best match of grain. Align them, mark, glue and nail drawers to faces.

Apply a thin coat of sealer to all inside areas and inside and outside of drawers. Stain and finish.



GLUE PAPER scraps so filler blocks can be removed easily with chisel. Fifth leg (center) has through slot.

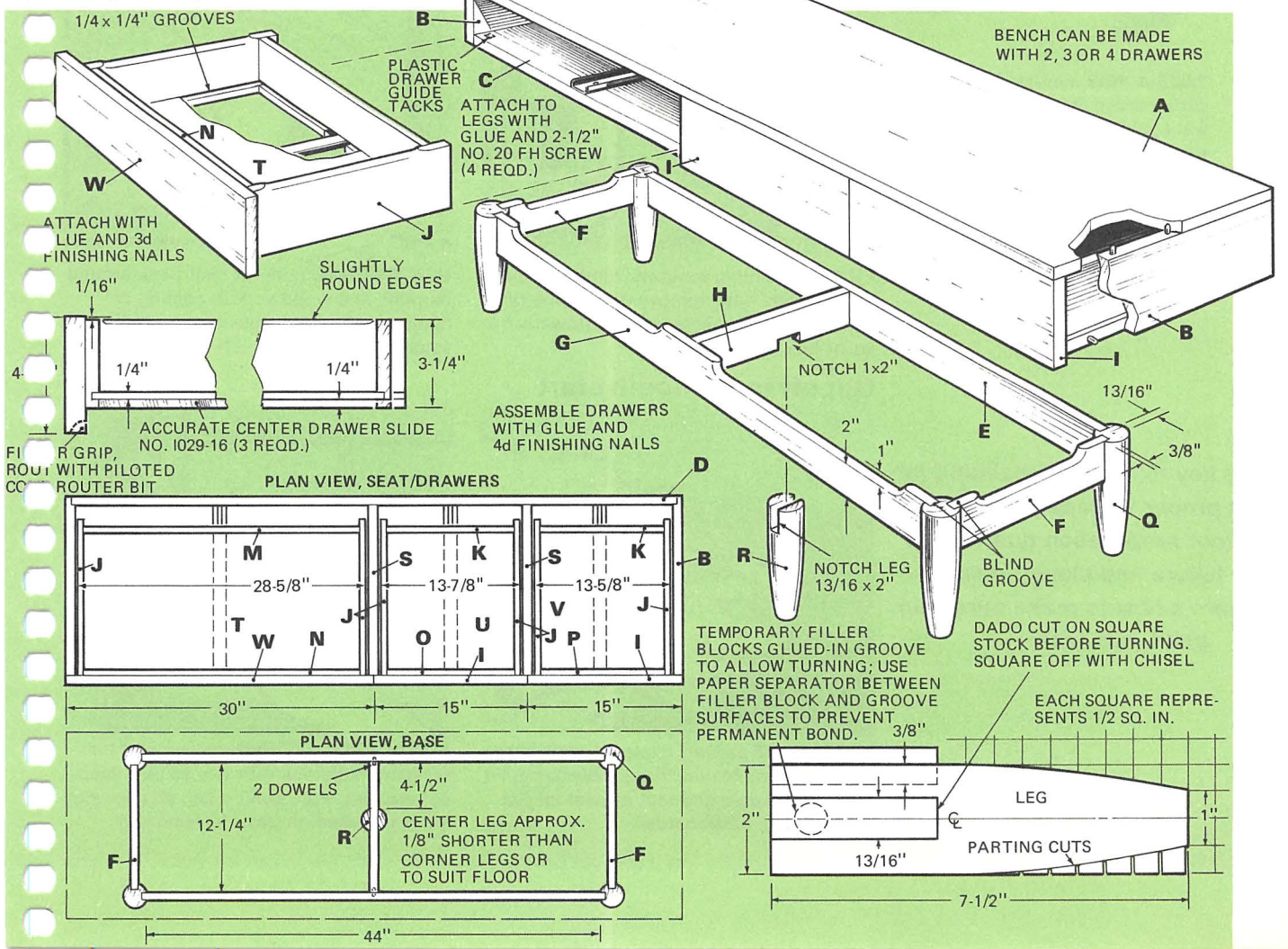


SPIRAL-GROOVED dowels allow excess glue to escape. For plain dowels, ane a glue-escape flat on one side.

MATERIALS LIST—TABLE/BENCH

Key	Pcs.	Size and description
A	1	13/16 x 18 x 60" poplar
B	2	13/16 x 4 3/16 x 17 3/16" poplar
C	1	13/16 x 16 3/8 x 58 3/8" poplar
D	1	13/16 x 4 3/16 x 59 1/8" poplar
E	1	13/16 x 3 x 44 3/4" poplar
F	2	13/16 x 3 x 11 3/4" poplar
G	1	13/16 x 3 x 44 3/4" poplar
H	1	13/16 x 3 3/8 x 12 1/8" poplar
I	2	13/16 x 4 1/4 x 15" poplar
J	6	1/2 x 3 1/4 x 15" pine
K	1	1/2 x 3 1/4 x 12 7/8" pine
L	1	1/2 x 3 1/4 x 12 5/8" pine
M	1	1/2 x 3 1/4 x 27 5/8" pine
N	1	1/2 x 3 1/4 x 27 5/8" pine
O	1	1/2 x 3 1/4 x 12 7/8" pine
P	1	1/2 x 3 1/4 x 12 5/8" pine
Q	4	2 x 2 x 7 1/2" poplar
R	1	2 x 2 x 7 3/8" poplar
S	2	13/16 x 3 3/8 x 16 3/8" poplar
T	1	1/4 x 13 15/16 x 28 1/16" hardboard
U	1	1/4 x 13 15/16 x 13 5/16 hardboard
V	1	1/4 x 13 1/16 x 13 15/16" hardboard
W	1	13/16 x 4 1/4 x 30" poplar

Misc.: White glue; 3/8-in.-dia. dowel; 4 No. 20 x 2 1/2" screws; 3d and 4d finishing nails; 3 No. 1029-16 Accuride center drawer slides complete with plastic drawer-guide tacks; sealer; stain; satin polyurethane finish.

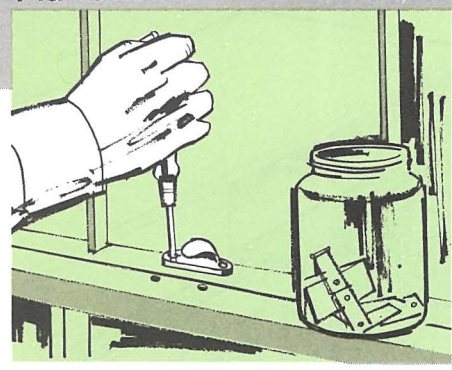


How to prepare surfaces so paint stays put

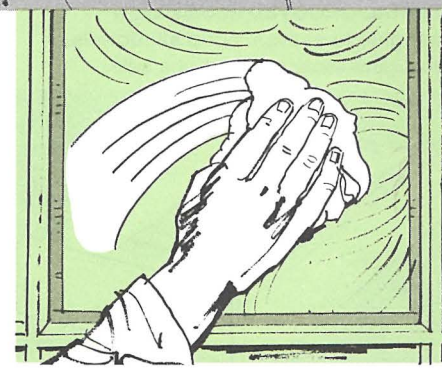
By JOSEPH R. PROVEY

TAKE A FEW minutes to protect surfaces and objects that you don't want painted. Remove wall hardware, fixtures and small furniture. Move larger furniture to center of room and cover with a dropcloth or newspapers.

Plan ahead



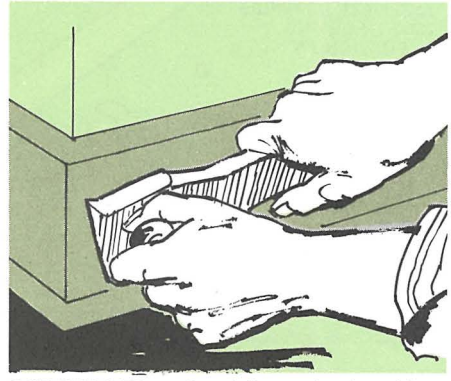
PRIOR to painting windows, remove latches and handles. Also remove doorknobs for best results. Store screws and hardware in a jar or box for safekeeping.



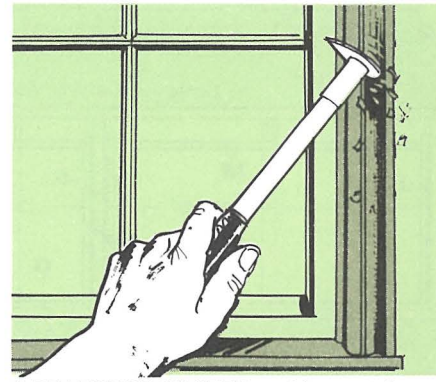
USE MASKING tape for neat work around muntins and woodwork. A coating of opaque household glass cleaner will make splatters easy to wash off.

The key to a quality painting job is proper surface preparation. Poor preparation guarantees failure and sloppy results. Here's how to make sure *your* paint jobs last

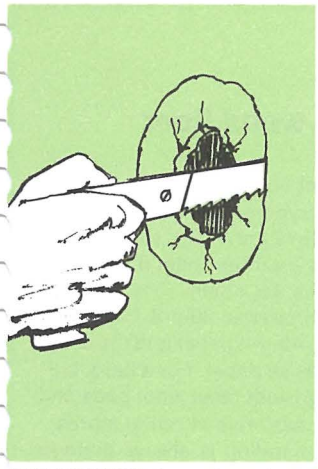
Get off to a smooth start



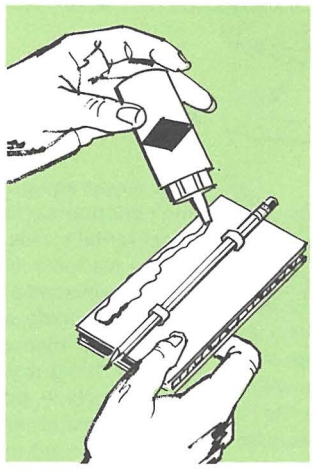
SCRAPE OFF peeling, blistered paint with a broad putty knife or with specially designed scrapers. Wide-blade tool is ideal for flat surfaces like baseboards.



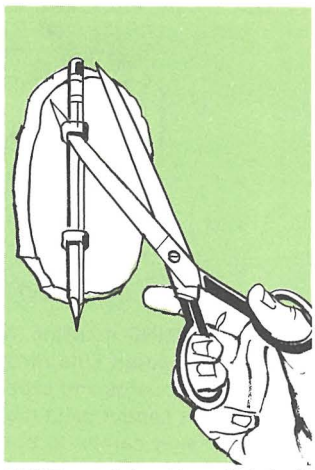
A TEARDROP-SHAPED tool is great for scraping moldings with curved and deep-cut grooves. Pull, don't push, scraper into loose or caked-on paint to remove it.



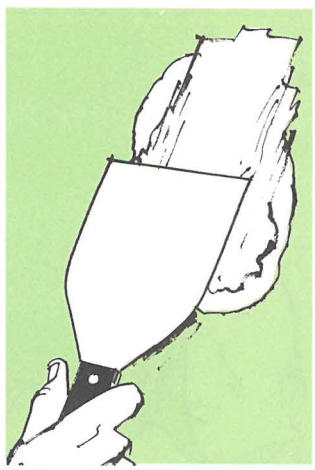
USE KEYHOLE saw to cut away damaged area (round hole). Measure hole and cut rectangular patch backing from corrugated box material so that it's larger than the hole. Backing must be narrow enough to fit in the hole.



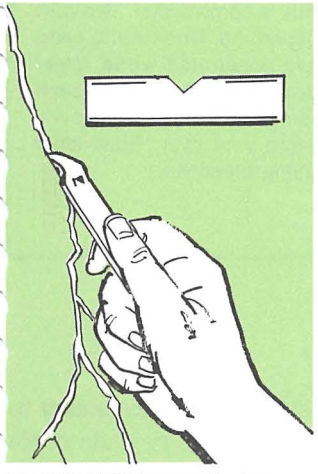
PUNCH two holes in corrugated backing, thread rubber band through holes and secure pencil or dowel through two loops. Dowel should hold to backing with slight tension. Squirt glue around the perimeter as shown.



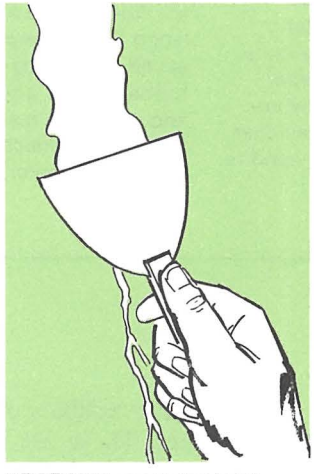
BEND patch backing slightly, if necessary, to insert and clamp in place as shown with dowel and rubber band. Allow glue to dry 24 hours, then snip off the rubber band with scissors. Push lightly against the backing to test.



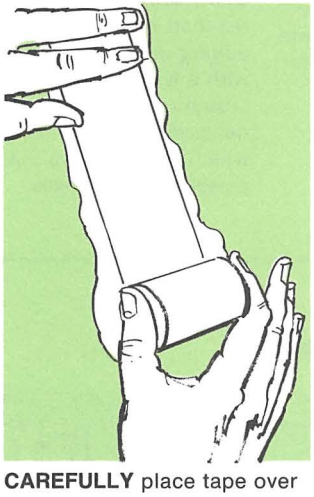
MOISTEN edges of hole and use taping knife to fill in area with joint compound. Use tape with second coat to prevent cracks; finish with thin third coat. Sand compound smooth and then seal surface with primer.



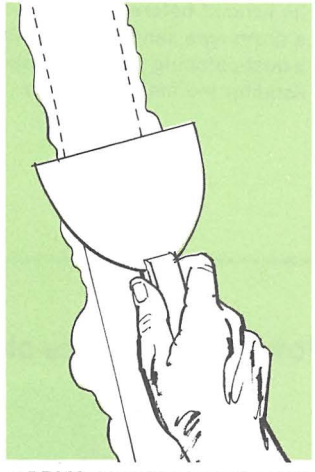
CLEAN OUT loose plaster debris from crack with utility knife or with punch-type can opener. If crack is in wallboard, use a sharp utility knife to cut paper layer on surface to prevent ragged tears while scraping.



PREPARE crack for joint compound by moistening area using a damp sponge. Use a 4-in. taping knife to force joint compound in crack and to provide a bed for wallboard tape. Gauze-type tape is the best for plaster.



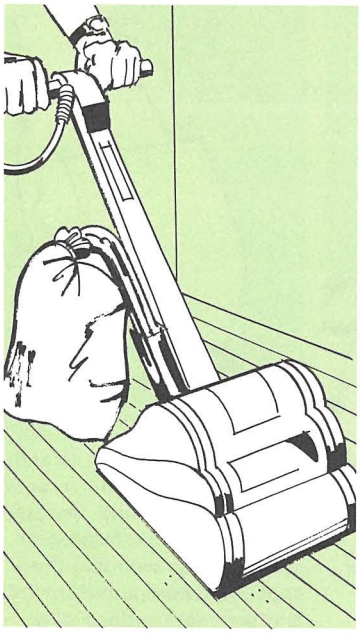
CAREFULLY place tape over buttered crack with fingers. Use taping knife at 45° angle to embed tape in compound and squeeze out excess compound. Apply a skim coat. Then remove air bubbles with a razor blade.



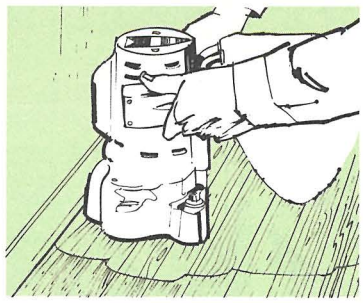
APPLY at least two more coats, but wait for the previous one to dry. Sand away high spots between coats, being careful not to oversand adjacent paper surfaces on wallboard. Prime the patch after giving it a final sanding.

■ PAINTING the inside of a room is like putting icing on a cake—most of the work goes into preparing what's underneath the goo. Just as with baking, ill-conceived shortcuts can cause more work than if you had taken the time to do the job right in the first place.

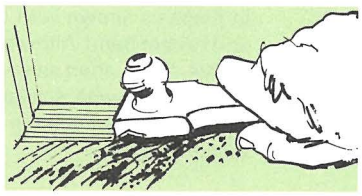
Accept the fact that surface preparation and painting are inevitably messy. You can't be too careful about protecting nearby objects and surfaces. Masking tape is the paint-it-yourselfer's best friend. Apply it just prior to painting to protect bordering areas from splatter and paint mist. New, pressure-sensitive tapes, like Easy Mask by the Daubert Chemical Co., do not leave



WHEN A FLOOR has been worn to the bare wood in spots and has begun to crack or discolor, it should be sanded before refinishing. Rent a drum-type sanding machine with a dust-catching bag attachment for sanding the main floor area.



AN EDGING machine, which can also be rented, cuts into areas close to baseboards and saddles where a drum sander can't reach. Be extremely careful to keep sander moving uniformly, so as not to cause uneven gouges.



CORNERS which cannot be reached with a drum sander or edging machine should be done with a well-sharpened scraper. Liquid removers are usually unnecessary and can leave residues which retard drying. Hand-sand to glasslike smoothness.

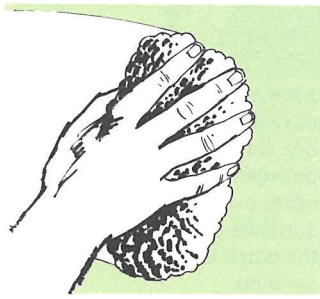
Resurfacing a wood floor

The power equipment needed to make refinishing your floors a do-it-yourself job is available at most rental stores. Have the dealer explain how to use his tools. Hire a professional if you have doubts—mistakes can be costly. The first cut should be made with coarse, 20-grit paper, the second with medium, 40-grit paper and the finish cut with 100-grit abrasive paper. For a hard, burnished surface, polish with steel wool pads and power polisher, also available at rental stores.

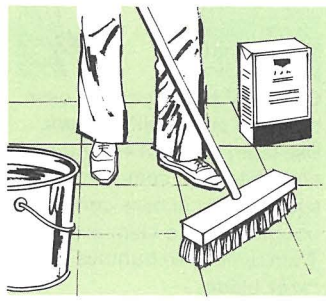
Keep in mind that sanding is always done in straight passes and *with* the grain. Keep the drum sander moving forward once it contacts the floor or you will cause uneven surface depressions. Lift the spinning drum off the floor *before* you stop. Make your passes in one direction only, overlapping the previous pass by about 2 in. Reverse direction of the sander to reach area close to starting wall.

Vacuum up dust thoroughly and wipe with a tack cloth before finishing. If there are stains in the floor, remove with a commercial, two-part wood bleach before finishing. Don't try to sand stains out if they have penetrated wood. Wear rubber gloves and goggles when using bleach and also when resanding spots later, so dust will not carry chemicals into your eyes. Read label instructions before using bleaches.

How to get surface clean



WHEN REFINISHING concrete that has already been painted, scrape and brush away flaking paint, sand glossy areas, and wash with TSP (trisodium phosphate) or a detergent to remove grease, oil and dirt. Rinse and allow to dry before finishing.



WALLS in kitchens or near furnace rooms usually require a scrubbing prior to paint application for best adhesion. Use TSP or commercially prepared detergents such as Spic and Span or Soilax. Rinse with clear water and let dry before painting.

adhesive residues on surfaces they're meant to protect. These 3¾-in.-wide rolls provide extra coverage, but follow the manufacturer's caution and don't use Easy Mask on lacquer-based finishes or peel-off-type wall coverings.

More important than covering furnishings is protection for your head and body. A cap with a brim, an old long-sleeved shirt, jeans and old sneakers are ideal—they'll save you much scrubbing and shampooing. To protect your eyes, skin and lungs, use safety goggles, gloves and a combination respirator/dust mask as the task demands.

Interiors usually require no extensive scraping, except where thick layers of paint have built up, or where moisture has caused blistering and peeling. If scraping is necessary, do it first.

Scraping tools come in all sizes and shapes. Use 1-in.-wide scrapers around window sash and trim, and 2½-in. bladed tools on baseboards

and other wide surfaces. Several makers design their tools with double-edged, high-quality steel blades that can be file-sharpened or removed for easy replacement.

A scraper should be pulled at an angle into the affected area. Pushing a scraper into the paint will dull your blade faster. Apply a constant downward pressure close to the blade with one hand and guide the tool with the other. Try a shaving motion for best results. File blade corners round to eliminate the possibility of gouging wood surfaces. Follow up areas that have been scraped with a thorough sanding. Feather out small ridges so they will not show through the finished coat.

Scrapers are also best for cleaning flaking paint off flat metal surfaces. On irregular-shaped metal and on masonry surfaces, use a wire brush, or wire cup brush chucked in a portable, variable-speed drill.

surface patching methods

Before you put away your scraping tools and sandpaper, make a thorough inspection of all surfaces for holes, cracks, ridges, dents and chips. Use scrapers to clean damaged areas of loose plaster debris; abrasive paper to smooth out and remove finish from dents and gouges in woodwork. Don't think about picking up a brush until you have finished all patching.

Clean small nail, hook or screw holes in drywall or plaster and moisten them with a water-wet brush or sponge. Then press patching compound into the holes with a putty knife, slightly overfilling them. Sandpaper moistened with water does a clean job of smoothing and feathering the edges of the dried patch to the wall surface.

Patch doorknob-size holes in drywall by following steps in the drawings. Don't apply too much joint compound at one time—the heavy glob may sag. Fill moderate-sized holes in two or three applications, letting each dry before proceeding to the next.

When large sections of drywall need repair, cut away the entire damaged section. Make the cutout as rectilinear as possible to simplify cutting the patch from drywall. Expose enough of the adjacent joists or studs to provide a place to nail the new patch. Toenail additional 2×4 nailers in position perpendicular to joists or studs and over the patch's two other joints.

The drywall patch should be the same thickness as the surrounding drywall. Nail it in place with gypsum wallboard nails, letting the last hammer blow make a slight dimple in the surface at each nail. Fill each dimple flush to wall or ceiling with compound. Also fill the channel between the patch and existing surface. Tape over joints the same way as you tape cracks (see drawings).

Hairline cracks in gypsum wallboard or in plaster should be opened to about ⅛ in. width and then filled in the manner prescribed for repairing small holes. Larger cracks around door frames or other areas should be repaired as shown in drawings. Moistening the crack with water prior to patching prevents the compound from drying out too quickly and assures a good bond.

When large, bulging areas of plaster have separated from the lath due to leaks or heavy impact, remove all loose plaster. If the lath is unsound, replace it. If it's still serviceable, undercut the edges of the hole and push old plaster keys aside. Next, wet lath and edges of the opening with water and apply a first coat of patching plaster to cover the lath. Work it through the lath spaces to obtain good keying and cover lath to a depth of ¼ in. Score ⅛-in. grooves in the first coat while it's still soft and let it set. Moisten the entire area and apply a second coat of patching plaster flush to the surface.

On woodwork or wood floor, use wood filler or wood plastic in nail holes and over scratches or gouges that go deeper than the old finish. Overfill the void slightly with a putty knife. When dry, sand flush.

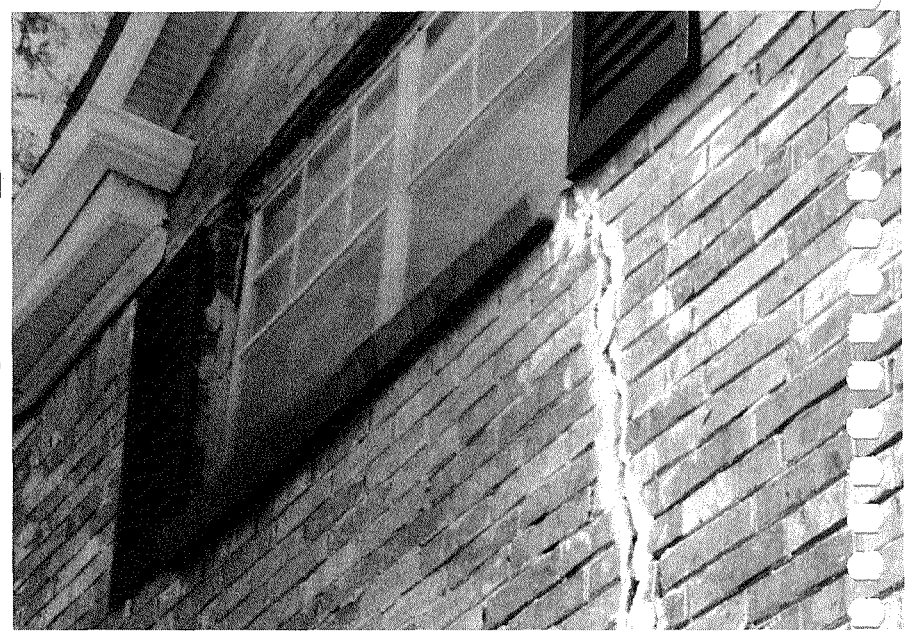
Patches in plaster, drywall or wood should be sealed to equalize rates of absorption between the patched area and the existing surface. This will prevent dull spots that might otherwise show up in the top coat. Either shellac, pigmented shellac or a suitable primer will seal pores in patching material.

last steps before painting

Even the best-quality paint won't adhere well to crayon graffiti, tape adhesive or greasy, waxy or sooty surfaces. Wash dirty plaster or drywall surfaces with TSP (trisodium phosphate), starting with the ceiling. Then, beginning at the bottom, wash the walls. Use household bleach to remove mildew. Rinse, using a sponge and clean water.

On wood surfaces, use turpentine or a commercial wax remover and clean rags to remove old layers of wax. Next, wash the surface with a mild soap and lukewarm water solution. Work with only a small amount of water, and wipe dry immediately with a clean, absorbent cloth.

Spot hidden troubles before you buy a house



By JOHN GAYNOR and BOB NEWBANKS

MANY LETTERS to *Popular Mechanics* start off by saying: "We just bought a house . . ." Followed by one lamentable problem after another. Although some of these defects would have been impossible for even a professional inspector to detect, many can be spotted by the unseasoned, prospective home buyer if he knows what clues to look for.

A handy tool for evaluating a house is the checklist on the opposite page.

Take a little time to familiarize yourself with the following brief explanations of the major checklist categories. Afterward, you should be able to face your next house-hunting excursion with confidence.

finding a preferred site

Although landscaping and vegetation around a house add to its desirability, don't forget also to take note of a site's functional aspects.

- The ground should slope away from the house, to prevent rainwater from seeping into the basement.
- City water and municipal sewer hookups are preferred to a well and septic tank or cesspool. If a house has the latter, ask who cleaned it out last and when.
- Gutter and leaders should be well fitted and maintained with no signs of leaks at the joints. Splash blocks should carry rainwater away from the house.

examining the building's exterior

A ladder may prove handy for this part of the inspection. When making your appointment, ask if one will be available—if not, bring one along.

- If the exterior is masonry, the mortar joints should be tight. Bricks that have sheared or stucco that has buckled may indicate that the structure has a severe settlement problem.
- If the exterior is of wood, observe whether the material is straight, flat and free of loose or split boards. All trim should be sound and free of rot.
- The house's coat of paint should have minimal chalking (dusty residue which comes off painted surfaces when rubbed) and be free of peeling and blistering.
- Caulked joints around windows and doors should be tight and pliable—not cracked, loose or crumbling.
- Adequate weatherstripping, insulated glass windows or well-fitting, easy-to-operate storm windows are other pluses.
- The roof should be vented at both the gable ends and soffits. Roof shingles should lie flat, not curled or cupped.

examining the interior

Cosmetic appearance of a house interior is important, but be wary. A recent paint job may be covering up some serious defects.

- Look closely for signs of diagonal "settlement" cracks on the walls over doors and windows.
- Close the doors and windows slowly and see if they close squarely.
- Does the floor bounce or squeak? Soft spots may indicate skimping on underlayment thickness.

■ Check for signs of water leaks at ceilings and walls.
■ Also look under sinks for signs of plumbing leaks.
■ Turn on bath and sink faucets and flush the toilet. All should drain rapidly.
■ If the owner does not know the thickness of his wall insulation, put your hand on the inside surface of an exterior wall. Then put your hand on an interior partition. The temperature differential should not be too great, no matter what the season.

Even more important when it comes to insulation is what's up in the attic. In most areas, its R-value should be about 30 (example: 10 in. of glass-fiber blankets or 14 in. of vermiculite).

A thorough look at the basement or crawl space can tell you a lot.

■ First check for signs of water seepage, which might show as mildew or mold on the walls or floors.
■ Also observe the general cleanliness. Piles of scrap wood or other debris left to rot on the floor are a stepping stone for termites. Be sure to ask the homeowner if he has a termite bond; get the exterminator's name. If he doesn't, call a reliable exterminator and have him make an inspection.
■ A crawl space should have vents in the walls and a plastic vapor barrier over the earth (unless there's a slab floor).
■ Look for signs of plumbing leaks under the kitchen and bathroom.

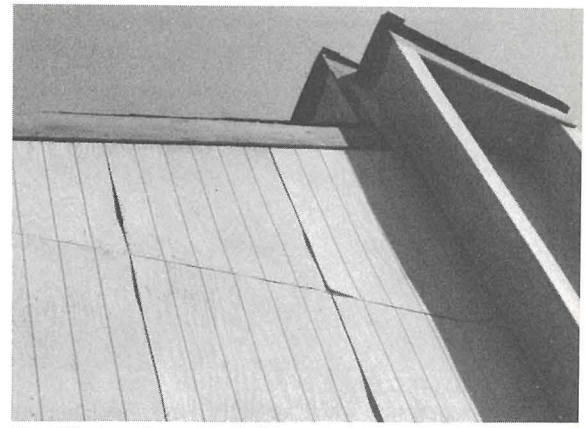
heating, airconditioning systems

This is one phase of home inspection where

HOUSE INSPECTION CHECKLIST

Site Characteristics:	Yes	No
Drives		
Walks		
Landscaping		
Lawn (slope)		
Water (municipal)		
Sewer (municipal)		
Fire hydrant		
Building Exterior:		
Roof shingles (flat)		
Flashing (sound)		
Ventilation (roof)		
Foundation (sound)		
Gutters and leaders		
Splash blocks		
Walls-brick		
Walls-stucco		
Walls-wood		
Caulking		
Trim (sound)		
Paint		
Storm windows		
Storm doors		
Screens		
Weatherstripping		
Building Interior:		
Walls (walls)		
Doors (square)		
Windows (square)		
Water penetration		
Signs of leaks):		
walls		
ceiling		
roof (attic)		
floors (sound)		
Basement & crawl space:		
sound walls		
sound joists		
dry		
vents		
vapor barrier		
plumbing above (dry)		
Exhaust fan (attic)		
Exhaust fan (ceiling)		

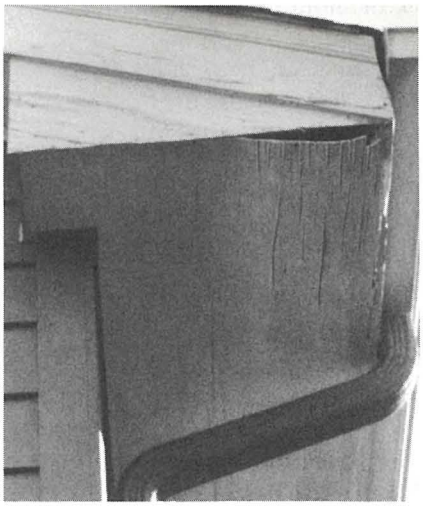
Bathrooms:	Yes	No
Ceramic tile		
Exhaust fan to exterior		
Good lighting		
Electrical outlet		
Kitchen:		
Floor (sound)		
Countertop (sound)		
Sink (no chips)		
Free of plumbing leaks		
Appliances-operating:		
range		
oven		
dishwasher		
garbage disposer		
range hood vented to outside		
Insulation:		
Ceiling (12" min.)		
Walls		
Electrical:		
Copper wire		
150 amp. min.		
Free of makeshift wiring		
Plumbing:		
Copper piping (best)		
Waste cast iron (best)		
Hot water tank:		
less than 8 yrs. old		
40 gal. min.		
sound (no rust or leaks)		
gas or oil-fired (avoid electric)		
Heating & airconditioning:		
Gas or oil heat (avoid electric)		
Ductwork insulated		
Less than 8 years old		
Previous maint. contract		
Model and make available		
Equipment looks clean		
Responds to thermostat		
Previous util. bills available		
Washer/dryer connections		
Termite bond		



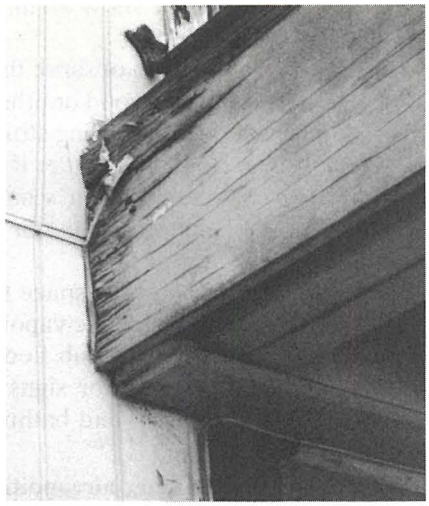
WARPED and buckled plywood siding often indicates that the panels were not joined on the studs—or that joints were not caulked.

EFFLORESCENCE (white chalky substance) stains on the walls and floors are telltale signs that there has been water seepage in the basement.

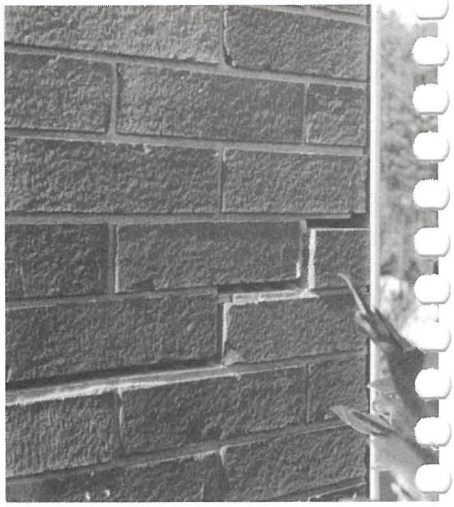
DAMAGE DUE TO WATER



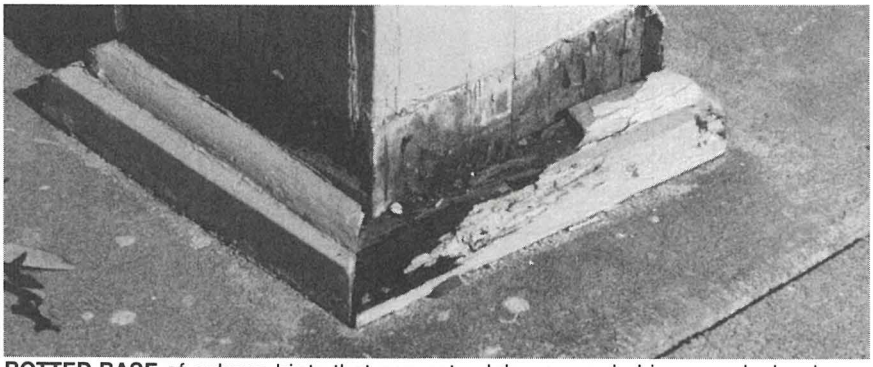
FLIMSY ¼-IN. plywood at soffit and rake return combines with shoddy workmanship. Warped soffit may mean a leak.



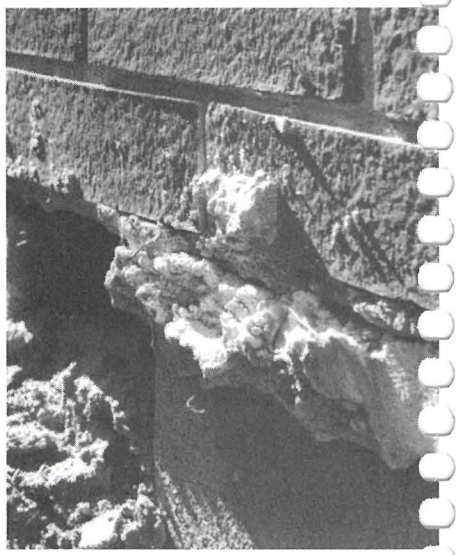
ROTTEN FASCIA is caused by lack of caulking at the joint and/or no drip edge or shingle overhang along eaves.



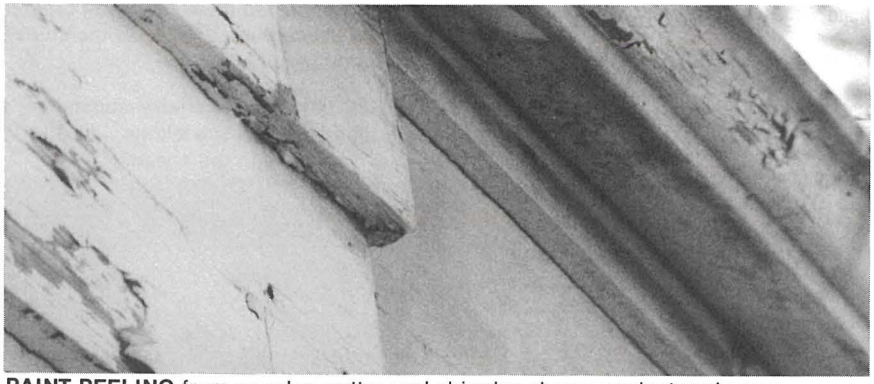
MASONRY VENEER crack at house corner indicates a lack of footing ledger under the first course of brick.



ROTTED BASE of column hints that concrete slab was graded improperly, leaving a depression which collects water. Peeling paint may also mean moisture.



SHODDY ATTEMPT to rectify omission of footing ledger can be seen here.



PAINT PEELING from wooden gutter and shingles shows neglect and poor maintenance. Inside of gutters should be tarred at least once every two years.

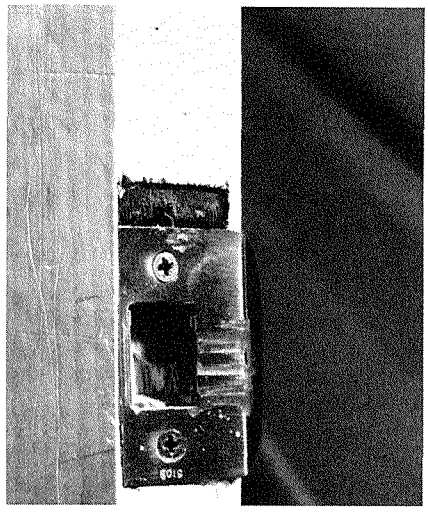
JOINTS between dissimilar building materials, such as at doorsill, should have been caulked to prevent water infiltration, leading to peeling paint and rot.

EXAMINING THE ROOF

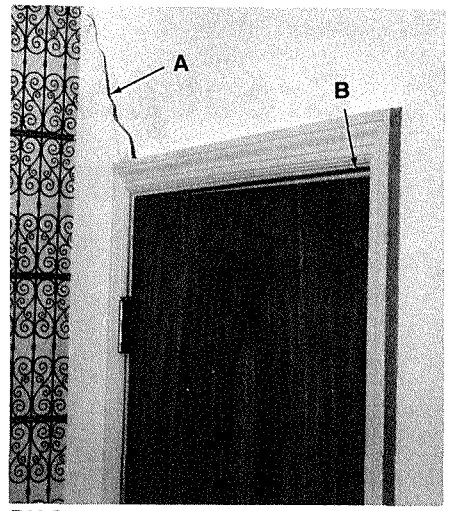
A LACK of flashing around the ba__of t chimney (A), no step flashing where th dormer intersects roof (B), and b__y cupped shingles (C) all combine t__ sp the need for a new roof. Also remember check for shingles where protect' mineral granules have worn away— another sign the roof is a goner.

SIGNS OF FOOTING SETTLEMENT

GAP (A) between brick veneer and siding is due to lack of wall ties. Caulk line shows how far brick has pulled.



LOWERED STRIKE plate is a clue to the house having settled—or may indicate amateurish lock installation.



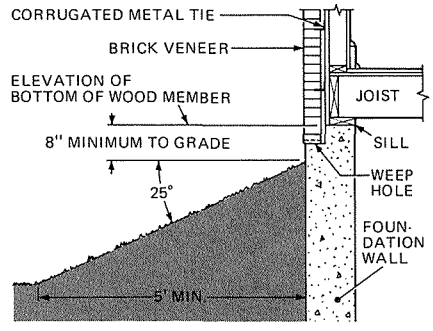
DIAGONAL crack (A) and sagging door (B) are two signs that the house you're inspecting has probably settled.

the neophyte buyer may require assistance. If the seller has a service contract, you've got it made. Call the company for an evaluation of the system. If there is no contract and the system is over eight years old, the amateur can only examine for general cleanliness of the equipment, burned or frayed wiring and signs of smoke stains on the housing.

■ Turn the thermostat on (*heat* and *cool*) and listen for a response from the equipment (a slight time lag is normal).

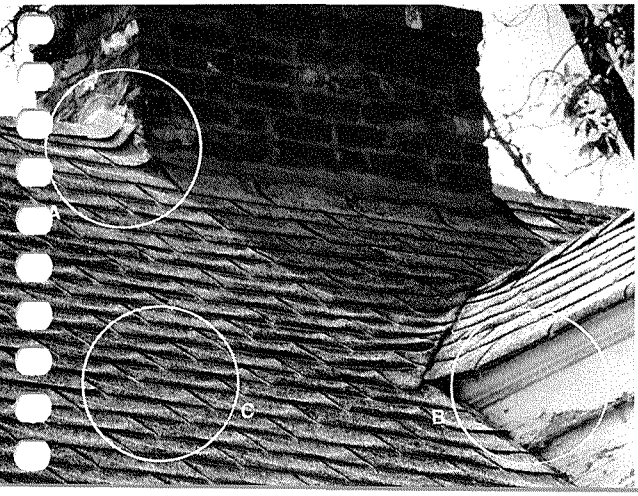
Don't be over-alarmed if you see indications of settlement. Settlement itself may have reached its limit and only require minor patching. If you have any doubt along these lines, have a contractor or engineer make a double check.

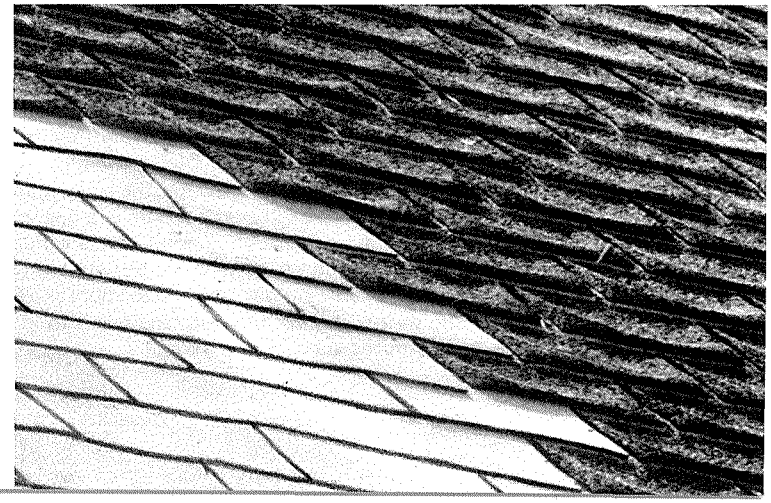
GRADE REQUIREMENTS AROUND A HOUSE



IF YOU'RE LOOKING at a home in an area where water runoff is a problem, check whether the ground slopes away from the house, as shown above. This helps to prevent puddles of rainwater from collecting close to the foundation, where the water would be most likely to seep into the basement. Also note how high the grade is in relation to the top of the foundation. The Federal Housing Administration requires a minimum of 8 in. between the structure's bottommost wood member and the outside grade.

PATCHED AREA is sure sign roof has leaked in past—and is likely to again. Exception to rule is where addition's roof has been spliced to existing roof.

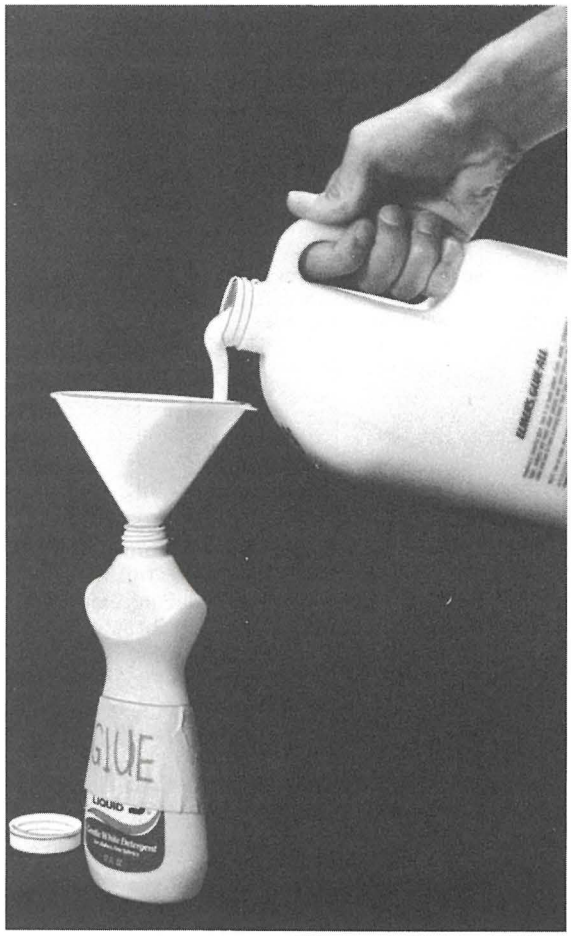




Great shop tricks from master craftsmen

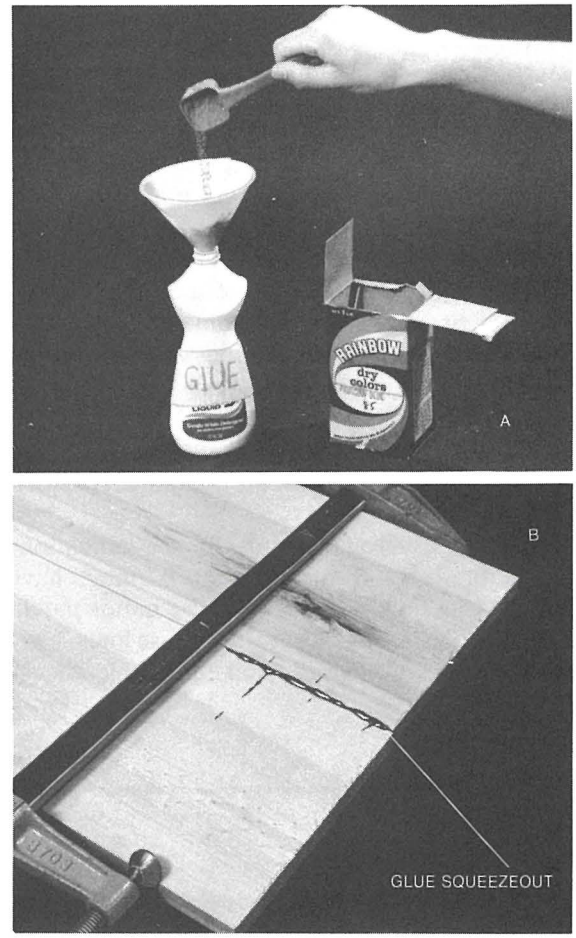
TIPS FROM CRAFTSMAN HARRY WICKS

Pay less for shop glue



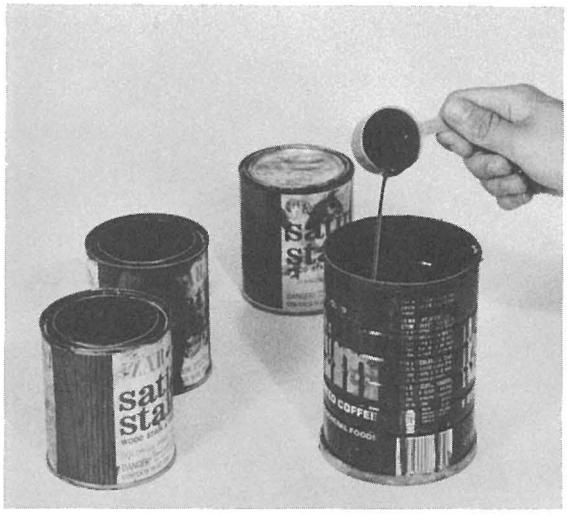
PROS HAVE LONG known that buying large quantities of glue is a sure way to save shop dollers. If you do a lot of shopwork, you should consider buying the stuff by the gallon. For easy use I pour the glue into thoroughly washed detergent bottles. Typical savings: the white glue shown cost $9.95 a gallon or 8 cents per ounce (a gallon is 128 oz.). By contrast, a four-ounce bottle of the same glue was marked at 99 cents, or 25 cents per ounce. That's a saving of 13 cents per ounce. For maximum shelf life, keep glue capped tightly and don't expose it to freezing temperatures such as in a garage.

Spotting glue squeezeout



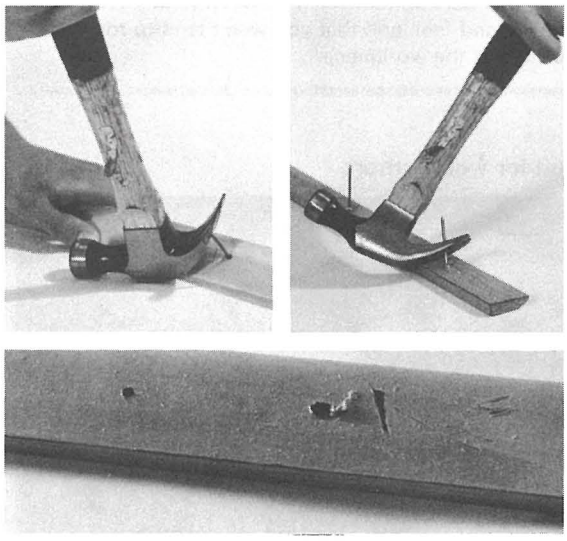
ALL WOODWORKERS learn early in their furniture-building careers that glue permitted to dry on a board seals the surface and spoils the stain job (i.e. leaves white spots). And, since white glue is just about invisible against white pine, it isn't too difficult to miss a spot that should be wiped. To make it easy to find excess glue, try tinting the glue with a small amount of blue or red chalkline powder. It won't affect the glue's holding ability, but will make it easy to spot when it oozes out of a joint. Remove any unwanted glue from wood surfaces by wiping it off completely.

Mixing your own stain



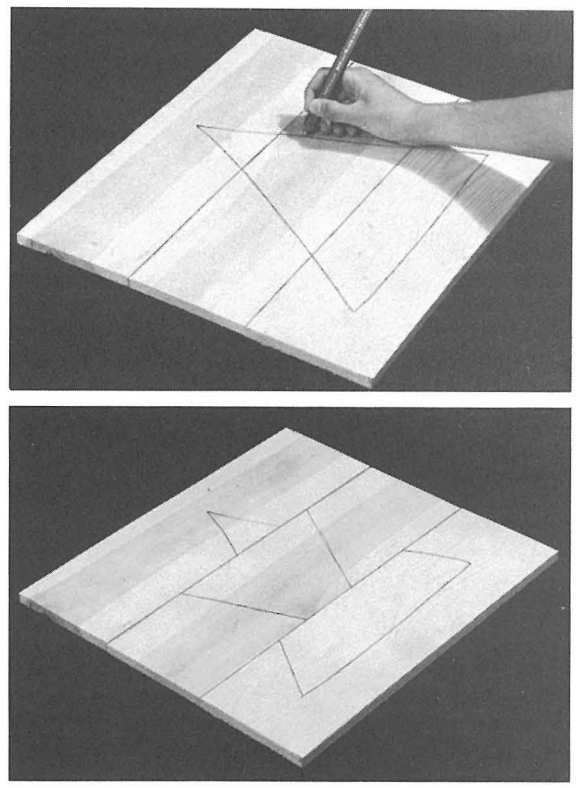
IT IS OFTEN desirable—and frequently a must—to mix your own stain color, rather than use one right from a can. In fact, if you stock your paint shelf with three stains—mahogany, walnut and maple—plus some umber and sienna pigments, you can mix just about any color you want. To avoid waste, use a small coffee measure to determine correct proportions of the various stains to use. When you are satisfied with the tint—on a scrap of the project wood—mix the stain in the volume needed, using proportions you determined with the measuring cup.

Reusing expensive moldings



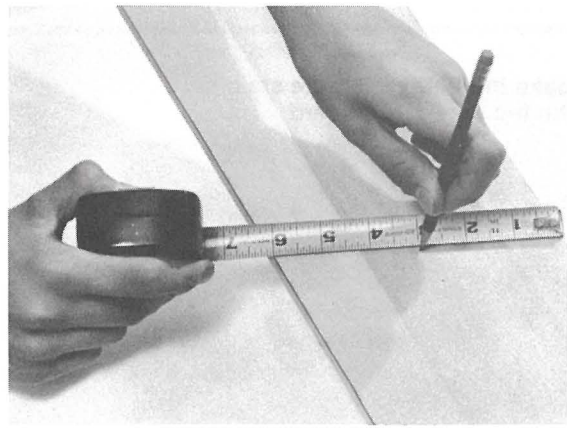
WHEN A PIECE of molding is removed from a wall or the like, nails should be pulled immediately to prevent any chance of a job accident. If the lumber is to go on the trash pile, the finishing nails can be pulled from the front (top left). But, when the molding is expensive and must be reused, pull the nails from the back side (top right) to avoid damage to the surface (photo above). For extra leverage when pulling nails, use a block of wood beneath the hammerhead.

Better match marks



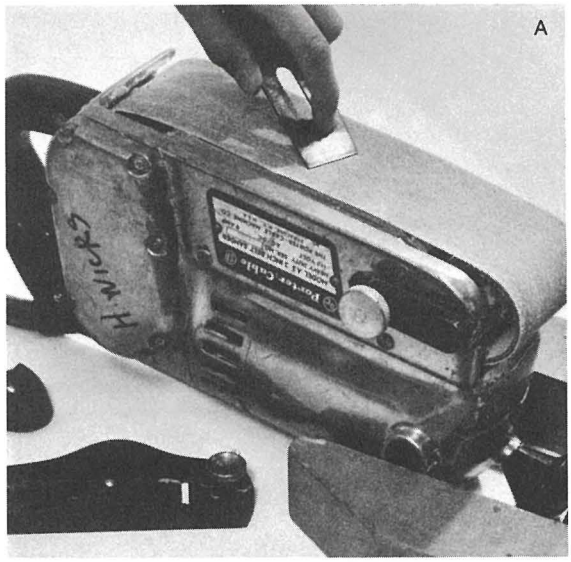
ASSEMBLING and disassembling projects on the workbench for test fit is a necessary part of cabinetmaking. To save frustration and to avoid the possibility of aligning parts with the wrong match marks, I use the triangle method shown above, instead of lines across the joints. Used on the backs of completed drawers, this method tells quickly and accurately to which opening a particular drawer is fitted.

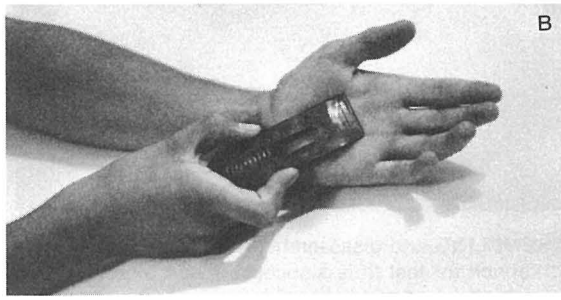
Find board center quickly



HERE'S AN OLD carpenter's stunt for finding the center of an odd-width board in a hurry—without having to calculate fractions and the like. Line up the top corner of your rule with one edge of the board and swing the outboard end up until an even number is on the second edge. Then divide the whole number by two; here, six divided by two locates the board center at the 3-in. mark.

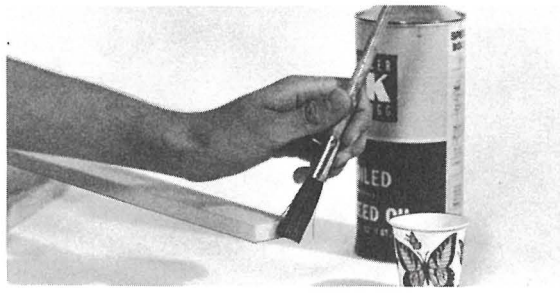
2 emergency sharpening stunts





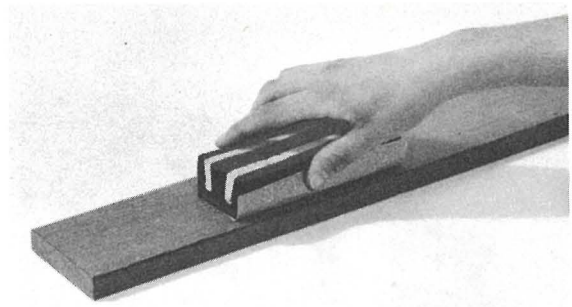
WHEN YOU'RE away from your shop, with its handy grinder, here's a good way to give plane irons and chisels a cutting edge touchup. Install a 120-grit or finer belt on your belt sander and clamp the tool securely. Then hold bevel against the moving belt to restore a slightly nicked edge. For a quick and temporary honing, try stroking the iron in the palm of your hand. Draw the iron so the cutting edge trails and you won't cut yourself.

Make the end grain take stain like the rest of the board



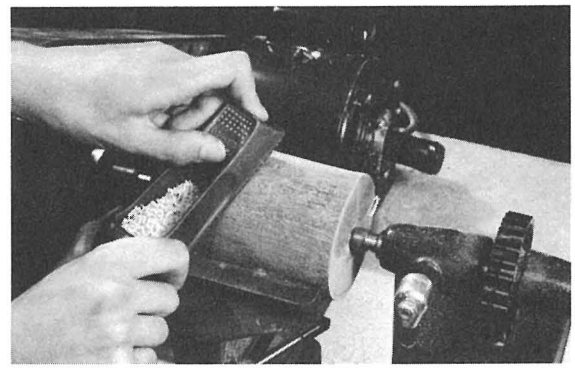
UNLESS the end grain is given some special attention before you stain, it is certain to soak up too much stain and turn almost black. To assure the exposed end grain taking stain evenly, first apply boiled linseed oil—as it comes from the can—using an artist's brush as shown. This slows stain absorption and permits wiping for good blend.

Hand sanding aid

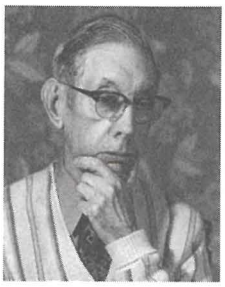


ONE OF THE handiest sanding tools that you can add to your finishing tool collection is an ordinary chalkboard eraser—it gives two sanding backup blocks in one. Its rigid back is perfect for sanding new wood when some pressure is desirable (top photo). But when you're working with finer grits, such as when sanding between finishing coats, flop the eraser and use the soft surface for paper backup (above). You will find this gives good control and feel, and that you won't tend to round the corners of the workpiece.

Aid for woodturners

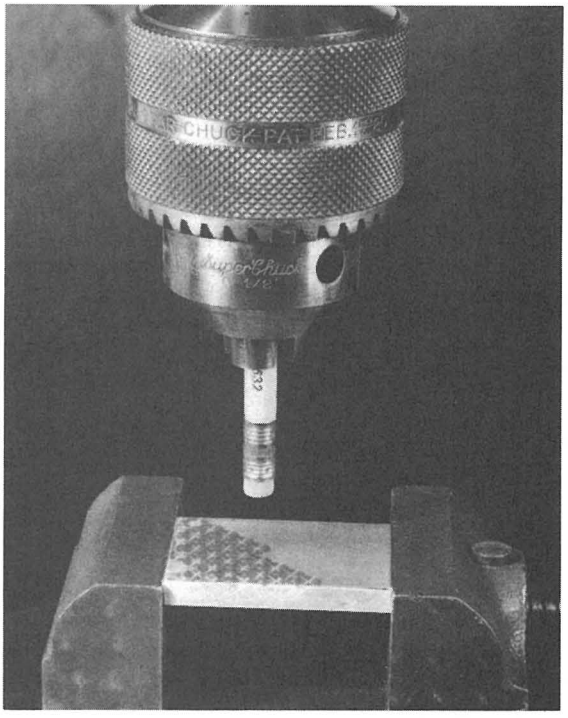


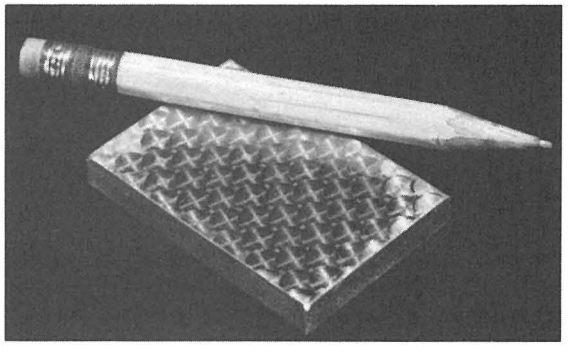
LIKE MANY woodturners, I use the deep gouge to rough-round stock and then touch it up slightly with a coarse file before proceeding with the turning. Recently, I discovered that Stanley's Surform tool makes the smoothing task a quick and easy chore. Make certain that the plane is held securely and that the toolrest has been adjusted, so that the plane does its cutting on the upper surface. Set lathe at a low speed.



TIPS FROM CRAFTSMAN WALTER E. BURTON

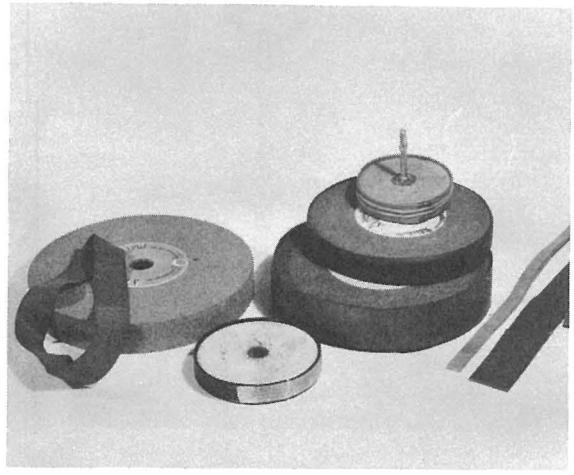
Decorating metal and plastic with a pencil eraser



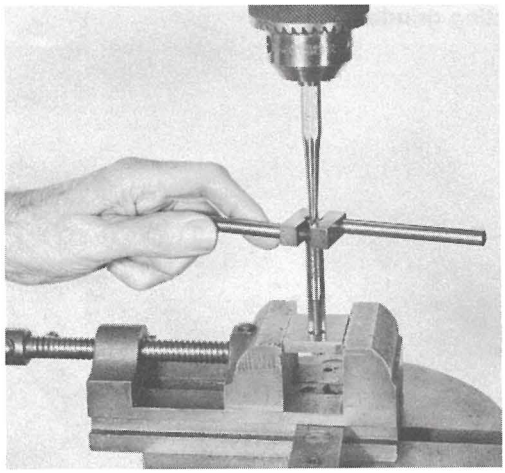


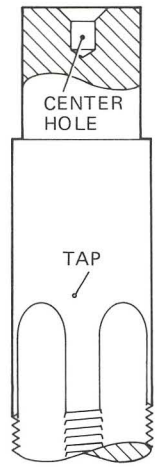
FANCY, POLISHED designs on smooth metal or plastic surfaces, similar to those sometimes seen on older watches, can be made with a flat-ended pencil eraser. The pencil is clamped in a drill-press chuck and brought momentarily against the workpiece surface to produce a spot. Drill-press speed need not be great. The spots are overlapped in various ways, by moving the workpiece freehand or with a milling-table attachment. If you don't like your results the first time around, you can erase the design by careful rubbing with a fine abrasive cloth and start over again. Freehand polishing can be done with the pencil chucked in a portable drill.

Protecting grinding wheels



TO HELP PROTECT grinding wheels against chipping while they are stored close together or when being roughly handled while off the grinder, encircle them with large rubber bands, strips of leather or other belting. Make the large rubber bands by cementing or stapling together ends of rubber strips cut from discarded bike-tire inner tubes. Cut the strips to suit the width of the wheel's edge. The old-fashioned book bands are also fine for making the wheel protectors. The bands should fit snugly so they'll be held in place by their own tension. Old trouser belts are a good source of leather. If you prefer to use nonrubber covers you can keep them in place either by gluing or taping the overlapped ends and/or securing them to the wheels with one or more ordinary rubber bands. Several of these methods are illustrated in the top photograph above.

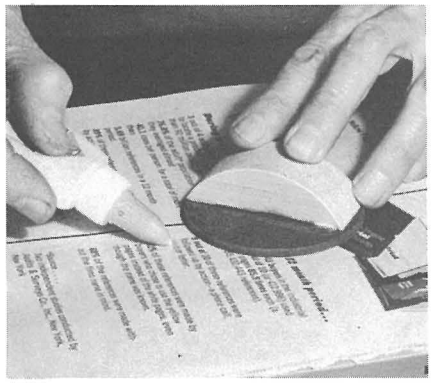




Starting taps straight with a drill press

A DRILL PRESS provides a handy way to start a threading tap straight, so it will cut cleanly and accurately. Clamp a center punch in the chuck and align it with the hole to be threaded. Tighten a tap wrench or clamping pliers on the tap shank. Then position the center-punch point in the tap's center hole. While exerting spindle pressure to keep the point in place, turn the tap slowly with the wrench. If the tap has no center hole in its shank end, you can either drill such a hole or clamp the tap directly in the drill-press chuck and turn it by hand, rather than with power.

Peel workbench pad



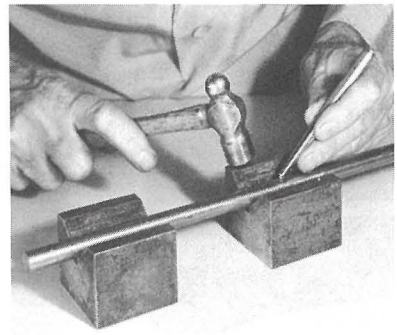
ONE OF THE BEST ways to recycle outdated mail-order catalogs, telephone directories or magazines is to put them to work as workbench pads. Such a pad serves many purposes: Use it for catching droplets of glue and for cleaning glue-bottle tips. Pads also provide a wiping area for cleaning brushes and a resilient "cutting board."

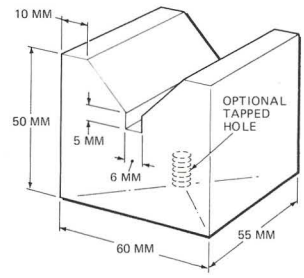
Invaluable V-blocks do many jobs

MANY YEARS AGO, I bought two steel V-blocks at a used-tool shop. Each weighs about 2½ lbs. and measures 50×55×60 mm. The pair have proved to be among my most useful bench tools.

V-blocks aid in holding cylindrical items, while spotting cross holes with a punch and later while drilling. They can also serve as weights for various purposes, substitute for light-duty anvils and help keep parts aligned while you are gluing them together.

One block has a threaded hole, which can convert it into a base for a magnifier or other instrument. Tap the hole to suit your needs. See the plan below for making a similar pair for your shop.





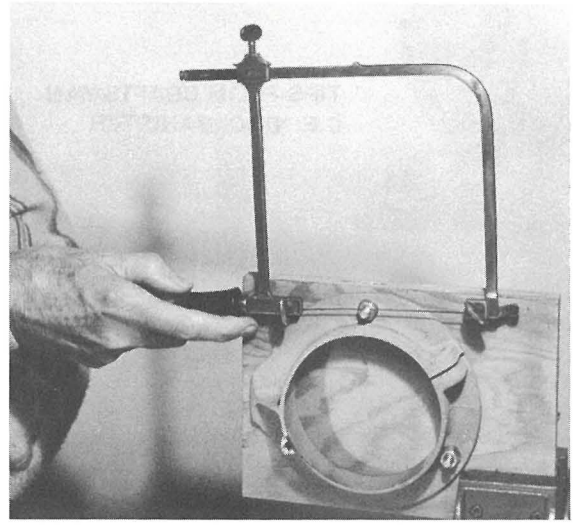
Sure sealing of paint-can lids

WHEN A PAINT can is opened and closed repeatedly, the lid inevitably accumulates an uneven deposit of hardened paint. To assure that it will seat tightly, the lid should be returned to the same position each time. In order to do it, make match marks on the lid and can side (see photo). These may be triangular as shown, or of other shapes coded to indicate paint type. When possible, the marks should be made with paint from the can to indicate the color inside of it. Tap lid snugly into the correct position between work sessions.

No-stick work surface for gluing

GLUED ASSEMBLIES have a habit of sticking to work surfaces while the glue sets. Make a useful shop item that provides a flat surface on which a glued-up workpiece can dry without sticking, by slipping a plastic food or shopping bag over a rectangular piece of hardboard. Most glues won't stick to the plastic very tightly, and you'll find that it's easy to peel off the plastic from the work. Such a work surface can be used for numerous other messy jobs, except for those that involve solvents which would dissolve the plastic.

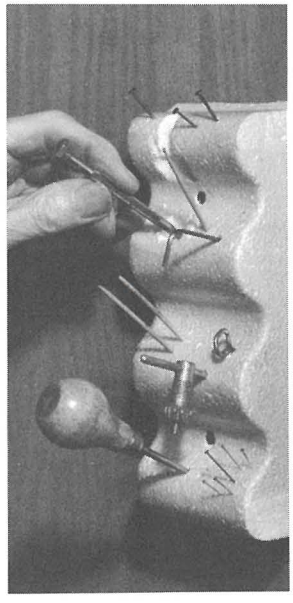
Jeweler's saw cuts bolts



IT'S SURPRISING what the skinny blade of a jeweler's saw can cut. I often use such a saw for removing excess lengths from bolts—even sizable ones (such as the ¼-20 bolt in the photo above). This tool makes a clean cut that requires little or no filing. A moderetaly fine blade serves for all-around use. It should be handled with care.

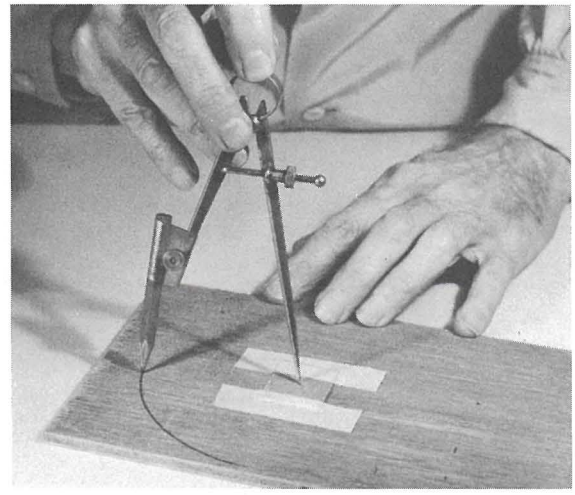
A blade lubricant, such as sulfurized cutting oil (not lubricating oil), will improve cutting action and prolong the life of the blade.

Foam packing is handy for storing small items

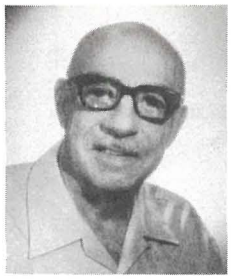


A BLOCK of rigid plastic foam, salvaged from a shipping carton for a camera or appliance, can be a useful workbench accessory. Mounted on a nearby wall, it is used to hold toothpicks, pins, small screwdrivers, awls, nails, screws and any other small items that can be pushed or turned into it. Note: If double-pointed toothpicks are stuck into such a pad (they are useful for applying dabs of glue), the sharp outer ends should be clipped off to prevent pricking your fingers as you reach for tools.

A 'portable' center mark



TO SCRIBE a circle on a metal, wood or plastic surface without marring the middle, position the compass point on a "portable" center mark. This consists of a shallow indentation made with a sharp-pointed punch on a piece of sheet aluminum or other metal. It's held temporarily in place on the workpiece with masking tape. The bottom of the metal piece should, of course, be completely free of any sharp projections to prevent the work from being scratched. After you have completed the scribing of the circle, you can peel off the tape and put aside the metal center for another job.

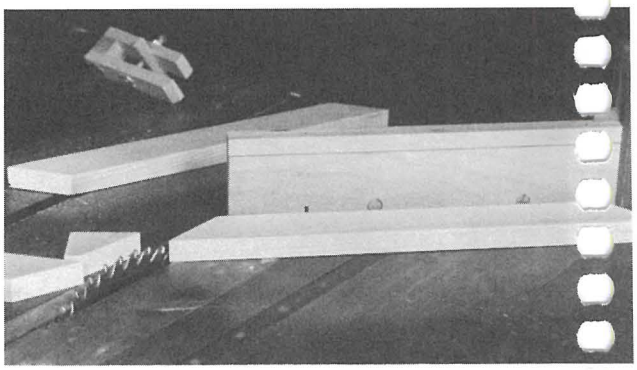


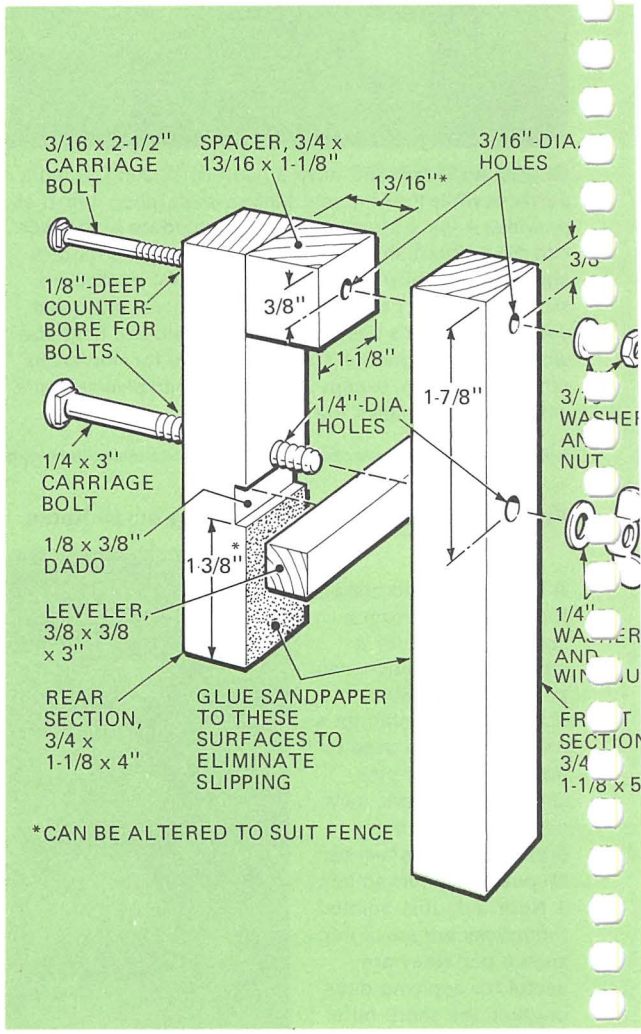
TIPS FROM CRAFTSMAN C.E. 'DOC' BANISTER

Adjusting center-opening doors that overlap or gap

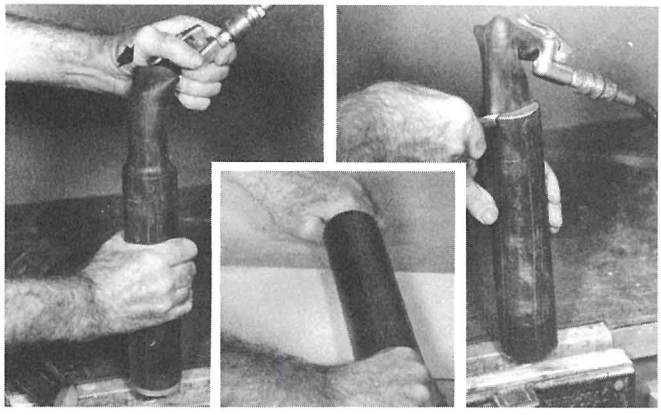
TO ADJUST pairs of doors that open from the center and overlap each other, loosen the hinge screws of one door (here, A) and between the doors place a shim (B) that is thick enough to force the doors past their normal locations. Then retighten the hinge screws. Repeat this process with the other door (C) if the two still overlap. Conversely, if there is an unwanted and excessive gap between the doors, loosen the hinge screws and place the shims between the stile and door rabbet. Then close the door and retighten the screws.

Jig for repeat bench-saw cuts





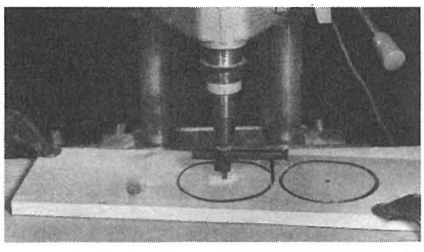
THIS STOP for repetitive crosscutting on the table saw is easy to make and requires few materials. Yet it's a very helpful shop accessory. It fits on a board attached to the miter gauge and functions as a clamp and a stop. Length of the lower part of the rear section is governed by the width of the auxiliary miter board on which it's placed. If there is a tendency for the stop to slip, glue sandpaper to the inner surface of the lower leg of both the front and rear sections to keep the stop secure when boards are positioned against it.

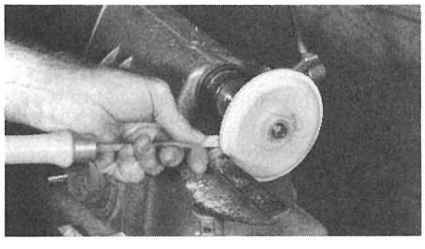


Tool for flattening laminate and veneer

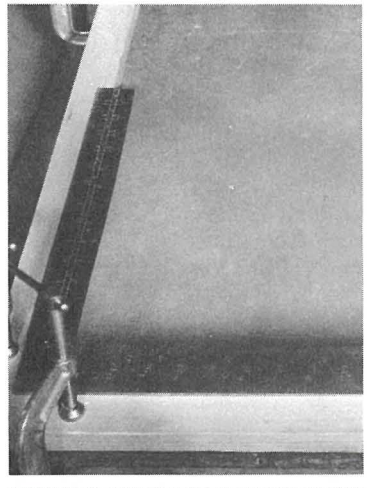
THIS IS A fine tool for flattening plastic laminate and wood veneer or mounting posters. It's simply a wooden rolling pin, which you can purchase or turn on a lathe, with a section of bicycle inner tube stretched over it. An air gun makes it easy to slip the tube on the cylinder. Stretch one end of the tube over the rolling pin. Use electrical tape to seal the other tube end to the nozzle of an air gun. The compressed air stretches the rubber so it can be positioned on the rolling pin. The tube slides down the cylinder on a cushion of air with little effort.

Stove bolt aids turning



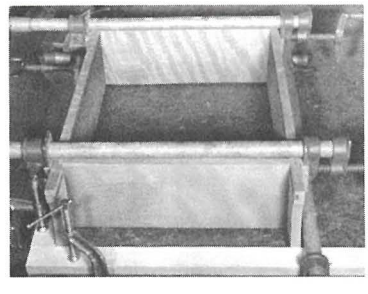


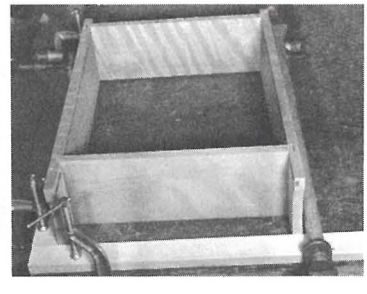
WHEN LATHE-TURNING wooden jar caps, wheels or discs up to 8 in. in diameter that require center attachment holes, cut the discs on a drill press with a fly cutter. Replace screw in lathe's screw center with a ¼x2-in. flathead stove bolt. The ¼-in. hole in the disc center fits neatly on the bolt. Secure the disc with a washer and hex nut and turn to tighten.



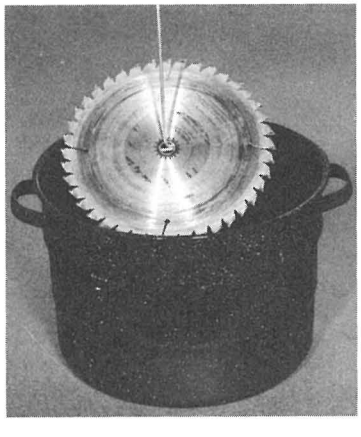
Squaring a case

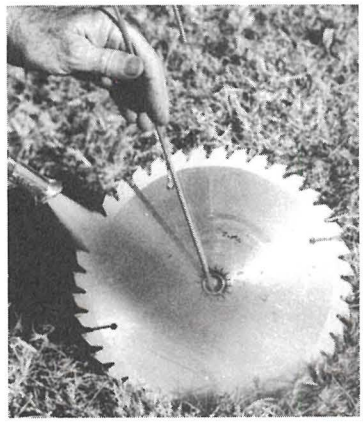
HERE'S A FOOLPROOF way to square a small or medium-sized case. Start by laying out and clamping a square corner on your workbench (left). Then use bar clamps to "rack" the case square. Clamp the cabinet top to the squared corner. Then run a clamp from top to bottom of the square. In extreme cases, insert a spacer in the corner opposite the latter clamp and pull the case *past square* and leave overnight. If it is needed you may want to consider adding more clamps after applying glue to the joints.





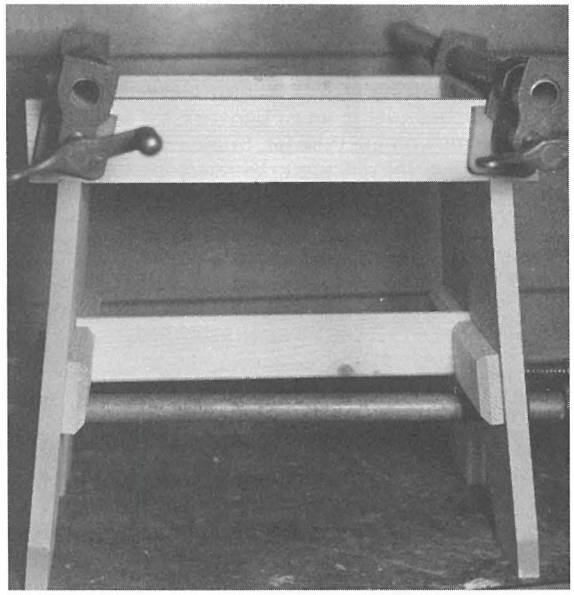
Cleaning saws and files





TO CLEAN pitch and scorch off saw blades, use an earthen, enamel or glass container that will hold a blade flat. Mix three tablespoonfuls of Drano with two quarts of water. Loop a wire through the arbor hole of the blade and lower the blade by the wire into the solution. Soak the blade for about five minutes. Then hose it off and thoroughly dry it. The blade should be as shiny as new. This solution also does a good job of cleaning wood rasps and files. However, soak these 10 to 15 minutes. Wash with a file card. As with any caustic or poison, store it in a place where children can't reach. Wear eye protection and follow the instructions for use on the label.

Assembling furniture with glue

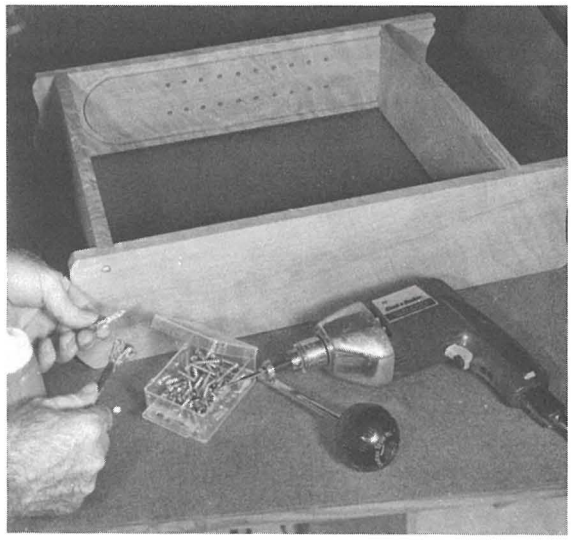


YOU CAN assemble cabinets and other furniture using only clamps and glue. Clean off glue squeeze-out with a damp sponge before it has a chance to dry. Using this method not only results in a need for minimal squaring, but the squaring can usually be done merely by shifting the clamps. Assemble chairs and stools on a flat surface. Check to see that all legs are plumb or, if splayed, are canted to the same angle.

Removing dents in wood

TO REMOVE hammer dents or other wood-crushing injuries, thoroughly wet a paper towel, fold it and place over the dented area. Apply a household iron set on "high." Steam will penetrate the dented wood and it will swell back to its normal level, filling the depression. Pass the hot iron over the wood to evaporate the excess moisture. Even large-size dents will respond to this treatment. Do be sure, however, that the wood is dried afterward before applying a new finish or coat of wax over it.

Fastening screws during assembly



WHEN INSTALLING wood screws, dip them in glue or spread glue on them before turning them into the wood. This stunt increases their holding power. The method is particularly effective when working with soft woods. After gluing the joints, keep the project in clamps for at least 12 hours, even if you use screws along with glue. Don't subject the work to undue strain for 24 hours to give the glue a chance to cure sufficiently.

Cutting sandpaper, cardboard and other shop materials

A GOOD-QUALITY paper trimmer will prove an invaluable aid around your workshop and home. You can use it to cut sandpaper to size accurately, neatly and quickly or to cut cardboard for templates, masks for painting trim and countless other projects. A good trimmer will even sheer thin metal stock for use as shims.

A drip can save you money in your garden

By ROBERTA LAWRENCE

WHAT DRIPS and saves both money and energy? If you have ever had a slow leak problem somewhere in your home, you will have a pretty good idea of how effective a trickle (or drip) irrigation system can be in your garden.

Trickle irrigation involves the frequent, usually daily, application of small amounts of water to plants. Water is applied slowly, under low pressure, to a plant's root zone.

Trickle irrigation saves water (and the energy needed to pump it) because it primarily wets the plants' roots. This leads to several other advantages: *weed control*—particularly when used in conjunction with a mulching system or black plastic ground cover—and *disease prevention.* The soil between plants remains dry, making it pretty tough for weeds to thrive. (To cultivate, you can temporarily peel back the emitting hose.)

The foliage of trickle-irrigated plants remains dry, and, since bacteria and fungi enter plants through pores in the foliage and depend on moisture to germinate, disease is reduced.

The main line of a basic drip irrigation system runs from a water faucet to the garden area. It can be a garden hose rolled out and connected when needed. You can also use ½-in.-dia. black plastic pipe, which can be buried to facilitate lawn mowing. In cold climates, this main line must be drained for the winter—blown out with compressed air if there is insufficient pitch for natural drainage.

At the end of the main line a pressure control valve reduces water pressure to 15 pounds per square inch (p.s.i.). Beyond the valve, a header hose runs perpendicular to garden rows across one end of the garden, or across the center if rows are longer than 60 ft. The header is ½-in.-dia. black plastic pipe with end cap.

Small feeder tubes connect the header to sections of emitting hose running the length of the garden rows. An ice pick or punch makes holes for inserting the feeder tube. Ends of the emitting hose are sealed with electrician's tape.

6 FACTS ABOUT TRICKLE WATER SYSTEMS

Install a trickle irrigation system on level or only gently sloping ground. Low-pressure systems utilizing standard emitting hose must be level, or laid out so water runs downhill with no more than a 2- or 3-ft. drop. Pressure-compensating emitters are also available. Systems using them can be installed on gentle hills.

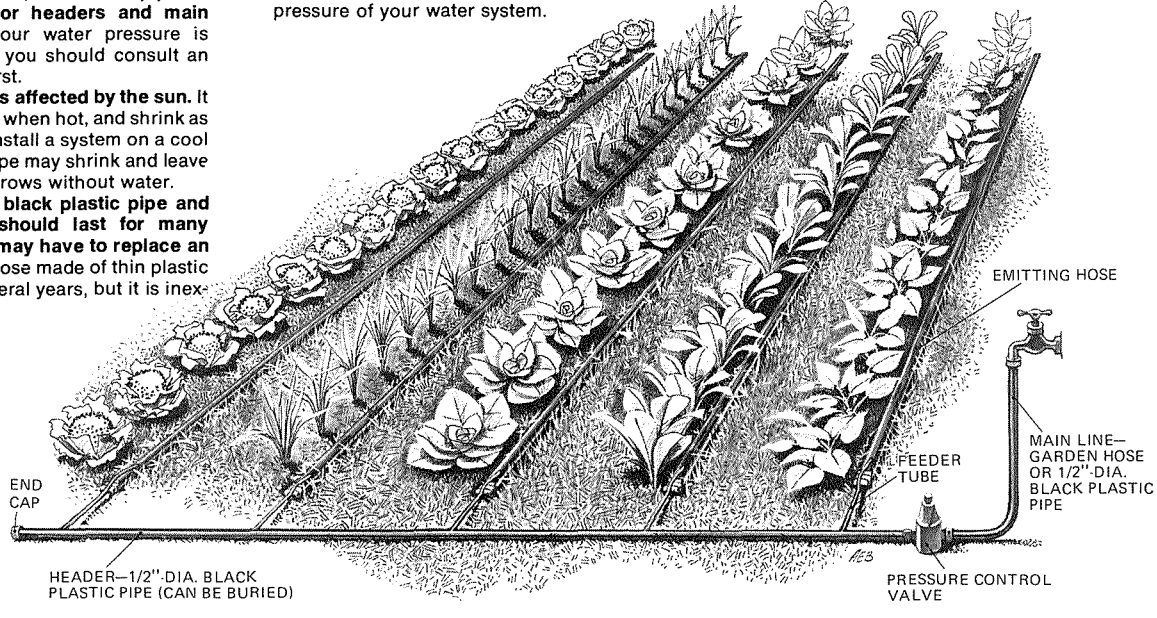
Generally, 80-lb.-test, ½-in.-dia. pipe is adequate strength for headers and main lines. However, if your water pressure is greater than 80 p.s.i. you should consult an irrigation specialist first.

Black plastic pipe is affected by the sun. It will soften and stretch when hot, and shrink as it cools. You should install a system on a cool day. Otherwise, the pipe may shrink and leave the ends of the plant rows without water.

A system utilizing black plastic pipe and individual emitters should last for many years, although you may have to replace an occasional emitter. Hose made of thin plastic film may last only several years, but it is inexpensive to replace.

You can apply fertilizer to plants through the irrigation system. For liquid fertilizers, an injection pump installed in the line can be used to supply a measured quantity of concentrated liquid to the garden area. These pumps are convenient, but expensive. Dry fertilizers are less costly than liquids and can be supplied from an in-line tank designed to withstand the pressure of your water system.

A trickle system can be automated. The easiest way to automate one is with a 24-hour time clock that operates a solenoid valve. Select a solenoid valve that is normally closed. The clock can be set to open the valve once a day for an hour or two. The length of this watering time can be adjusted to suit varying weather conditions.


EMITTING HOSE
MAIN LINE—GARDEN HOSE OR 1/2"-DIA. BLACK PLASTIC PIPE
FEEDER TUBE
END CAP
HEADER—1/2"-DIA. BLACK PLASTIC PIPE (CAN BE BURIED)
PRESSURE CONTROL VALVE

A tool chest fit for a master craftsman

By DAVID WARREN

The original is owned by a master carpenter. Here we present plans for duplicating this beautiful and functional chest right down to the last detail

ONE OF THE QUICKEST ways to judge the skill and ingenuity of a craftsman is to take a look at the condition of his tools—and how they're stored. There's no doubt that Patrick Murphy, builder of the prototype for this tool chest, is a top-notch finish carpenter. Well-organized hand tool compartments that allow easy access, wood construction that absorbs moisture and protects tools from rust, and details like drawer stops and locks reflect years of experience and pride in doing things well.

Our reproduction was built by Rick Eickhoff with few changes from the original. You can adapt the design to suit your own woodworking needs. Even if you file the chest plans for now, consider building the ever-handy dolly right away.

building the chest

Plane all the cherry boards needed for the case sides and lid top to 5/8-in. thick. To get wide enough boards for cutting some parts, smaller-width boards may have to be butt-joined with clamps and glue. Cut the glued-up boards to size and sand inside surfaces. You will need about 27 board feet of 3/4-in. cherry stock and 12 sq. ft. of 1/2-in. cherry to complete the project.

Note that upper chest sides C/E and D/F and top G in case assembly plans are assembled as a box. Afterward, the lid portion (E, F, G) is cut off with a table saw. Dovetail joints used at all four corners of upper and lower chest halves are, of course, optional.

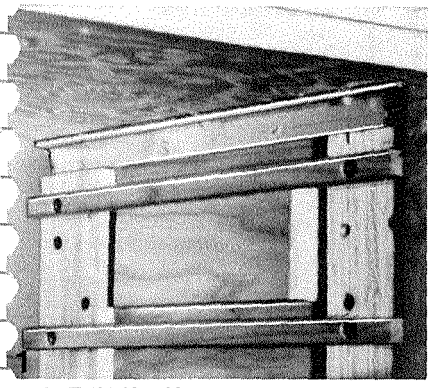
A fast way to cut dovetails is to use a router with dovetail-cutting bit and dovetail template. When laying out the dovetails for the upper section of the chest, center a pin on the line where the lid will be sawed free.

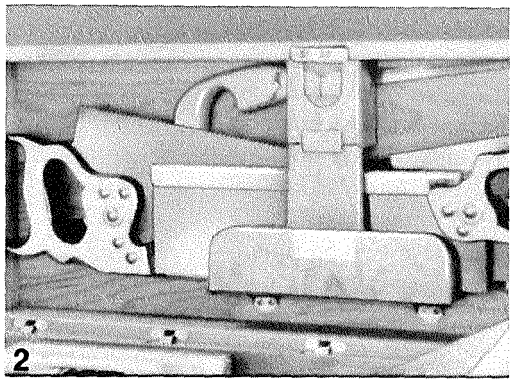
carving the side lifts

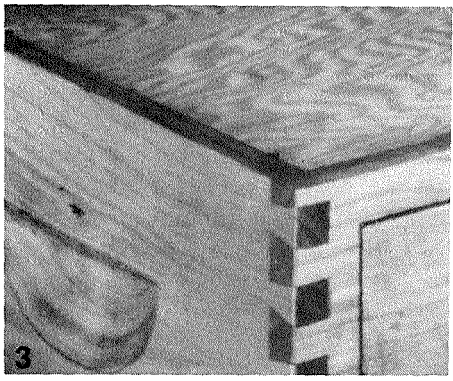
Before assembling the sides, glue the reinforcement blocks (H) inside the endpieces (A and C). The simplest and safest way to carve the recesses is with a gouge. Afterwards, smooth the concave area with sandpaper.

making lower chest half

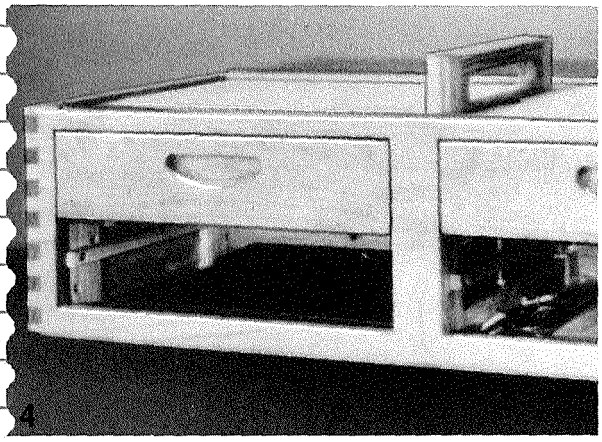
Cut all parts as shown in plans and assemble sides A, B1, B2 and plywood top M2. Bottom M1 is not glued into place until the retractable handle assembly, locking mechanism and aluminum angles have been installed. Note that part B1 in case assembly plans was cut from a single board for appearance. Reinforce the resulting weak

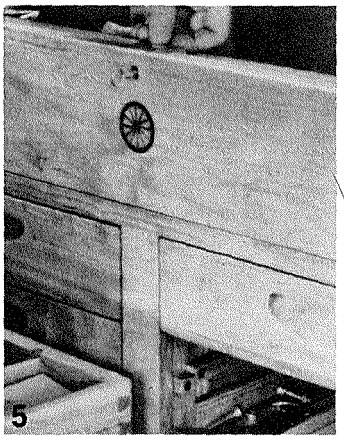


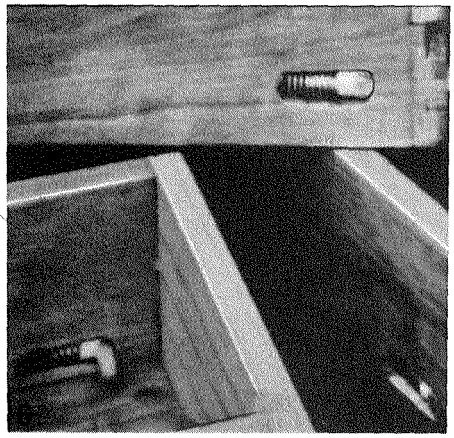




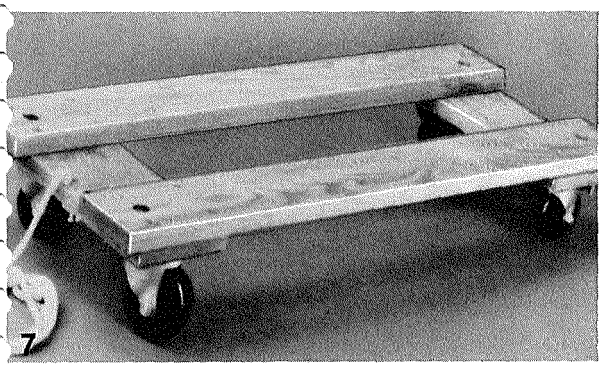
1. TWO HALVES of chest bolt together for storage. Aluminum angle inside lower half is drilled and lapped to accept bolts. 2. Grooved and slotted separators keep saws from jostling inside lid. T-shaped retainer pulls forward to allow saws to be removed. 3. Chests stack neatly. Recess in top of lower half (shown) accepts bottom of upper half. Dovetail corners add strength.

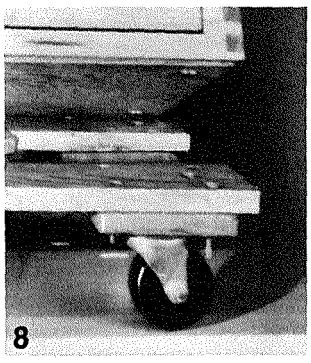






4. EVEN SPACE under drawers has a purpose: Clipboard, plans have niche on left; screw-in handle to unit top stores at right. Lower unit's retractable handle, drawer-locking mechanism fit behind drawer slide. 5. As lid closes, it depresses a pin which forces ½-in. sections of the drawer slides into mortises in drawer sides. 6. Drawer backs have spring-loaded stops to prevent too-far pull-out.





7. OAK DOLLY has heavy duty casters and makes toting chest over level surfaces easy. 8. Shallow recesses in dolly are sized to suit furniture glides that keep box from sliding off dolly during transport to the job.

center divider with spline J. This spline also functions as a vertical guide for the drawer-locking mechanism.

Cutouts for the drawers in part B1 weaken the dovetail corner joints. Use corner braces (K) to reinforce joints and for mounting drawer runners (L) in position.

Build drawers with stops, as shown in plans. Dovetail joinery is optional, of course. Carve pulls to match side lifts.

retractable handle

Assemble and install the retractable handle components next. The carriage bolt (M), anchored in piece B, has two stop nuts (N) to allow the handle to be lifted high enough for your hand to grab it.

installing lock mechanism

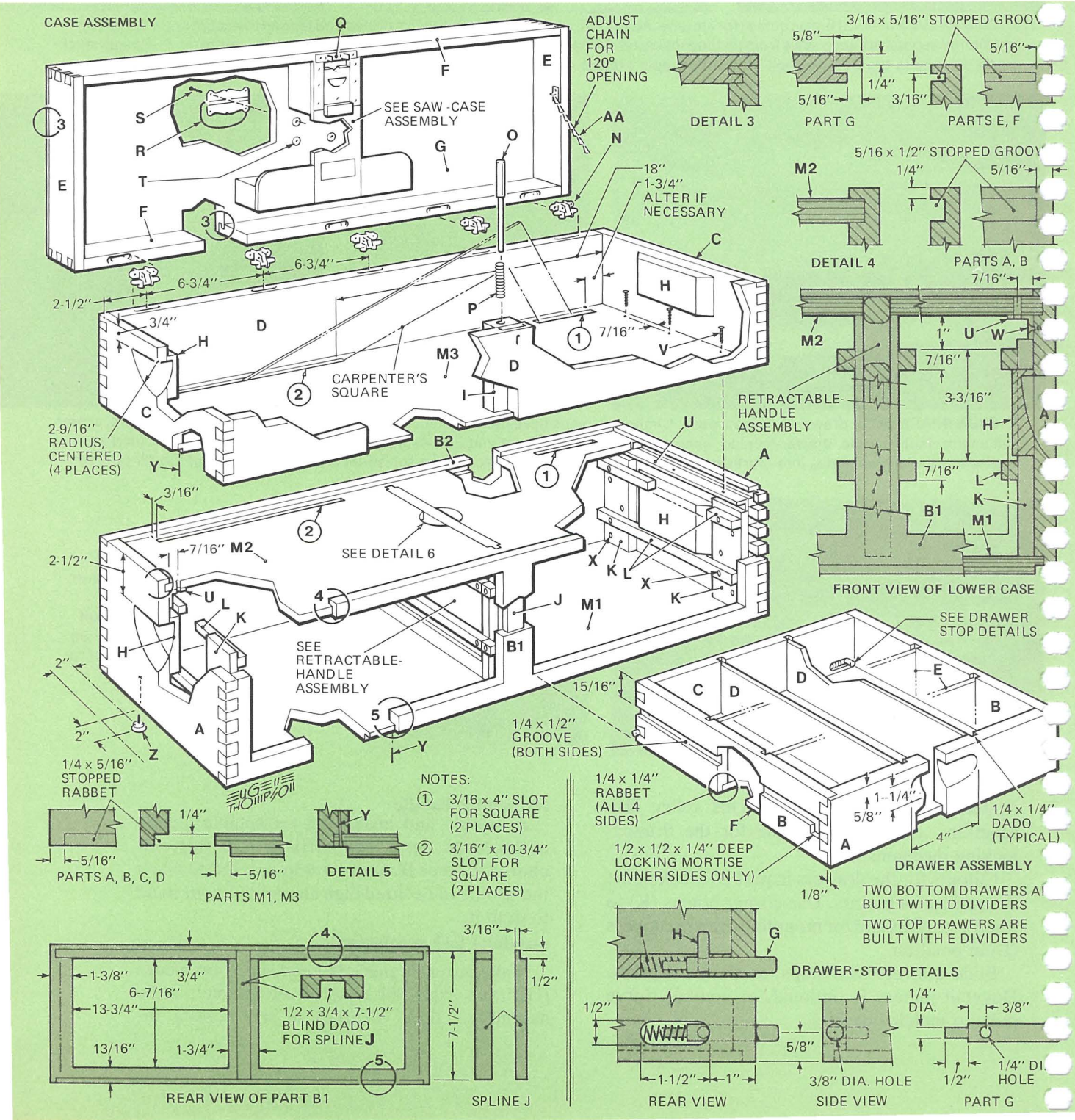
Make movable piece (F) and screw on pieces (G). (See exploded view of retractable handle assembly.) Bore recesses in the bottom for

springs (J). Cut out plywood bottom (M1) to fit rabbet in bottom of lower chest half. Then rabbet the plywood edge. Next mark and bore recesses in the plywood to accept the springs.

To assemble, invert the lower chest half, insert the handle assembly and drawer locking slide (F). Glue M1 into the rabbet and also spread glue on the plywood where it contacts part B (see side section view of handle). Use two 6d finish-

MATERIALS LIST—CHEST

Key	No.	Size and description (use)
A	2	5/8 x 8 x 12" cherry (lower case sides)
B	2	5/8 x 8 x 32" cherry (lower case front, back)
C	2	5/8 x 5 1/4 x 12" cherry (upper case sides)
D	2	5/8 x 5 1/4 x 32" cherry (upper case front, back)
E	2	5/8 x 2 3/4 x 12" cherry (lid sides)
F	2	5/8 x 3 x 32" cherry (lid, front, back)
G	1	5/8 x 12 x 32" cherry (lid top)
H	4	5/8 x 2 1/2 x 6" cherry (side lift reinforcement)
I	1	3/4 x 1 3/4 x 5" cherry (plunger guide)
J	1	3/4 x 5/8 x 7 1/2" cherry (front spline)
K	4	1/2 x 2 x 6 1/4" cherry (corner brace)
L	4	7/16 x 1/2 x 10 5/8" cherry (outer drawer runner)
M1	1	1/2 x 11 3/8 x 31 7/8" fir plywood (bottom)
M2	1	1/2 x 11 3/8 x 31 7/8" fir plywood (case panel)
M3	1	1/2 x 11 3/8 x 31 7/8" fir plywood (case bottom)
N	5	No. 101 Soss hinges*
O	1	5/8"-dia. x 6 3/8" steel rod



P	1	5/8″-o.d. x 3 1/8″ spring
	1	1 1/2 x 2 1/2″ No. K34 chest lock
R	1	Handle for top of case
	4	1/4—20 x 3/4″ fh machine screw
I	4	1/4—20 Teenut (to mount handle)
	2	1/8 x 3/4 x 3/4 x 10 5/8″ aluminum angle
	6	1/4—20 x 1 1/4″ fh machine screw
W	8	1/2 x No. 8 fh wood screw
	20	1″ x No. 6 fh wood screw
Y	as reqd.	6d finishing nails.
	4	3/4″-dia. bottom furniture glides
	as reqd.	Lid support chain, brackets and screws

...c.: Oil-type wood finish such as Watco Danish oil fin-, white glue, ebony for initials, inlay medallion.

MATERIALS LIST—DRAWERS

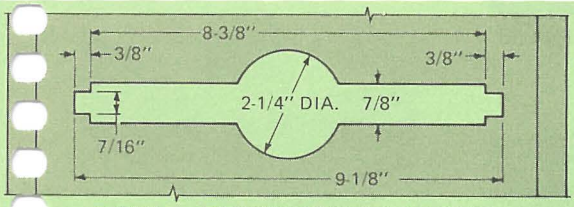
	4	5/8 x 3 1/8 x 13 5/8″ cherry (front)
R	8	1/2 x 3 1/8 x 10 7/8″ cherry (side)
	4	1/2 x 3 1/8 x 13 5/8″ cherry (back)
D	4	1/4 x 2 3/4 x 10 3/8″ cherry plywood (divider)
E	4	1/4 x 2 3/4 x 13 1/8″ cherry plywood (divider)
F	4	1/4 x 10 3/8 x 13 1/8″ cherry plywood (bottom)
G	8	3/8″-dia. x 2 1/2″ dowel lock
H	8	1/4″-dia. x 1″ dowel pin
I	8	3/8″-o.d. x 1″ lock spring

MATERIALS LIST—SAWHOLDER

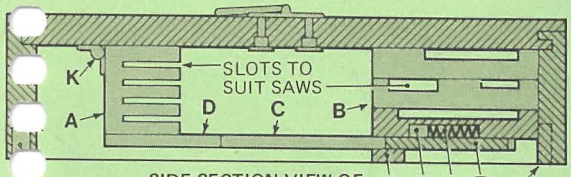
A	1	1 5/8 x 1 7/8 x 10″ cherry (base retainer block)
B	3	5/8 x 3 x 3 1/2″ cherry (retainer block)*
C	1	1/4 x 3 x 6″ cherry (vertical retainer)*
D	2	1/4 x 2 1/2 x 3 1/2″ cherry (horizontal retainer)
E	1	1/4 x 2 x 2 3/4″ cherry (catch piece)*
F	1	1/4 x 3/4 x 2″ cherry (catch piece latch)*
G	2	1/4 x 5/8 x 3 1/4″ cherry (catch piece retainer)
H	1	1/4″-dia. x 3/8″ (spring dowel)
I	1	1/4″-o.d. x 1 1/2″ (spring)
J	7	1/2″ No. 5 fh wood screw
K	2	Spring-loaded hinge*

MATERIALS LIST—HANDLE

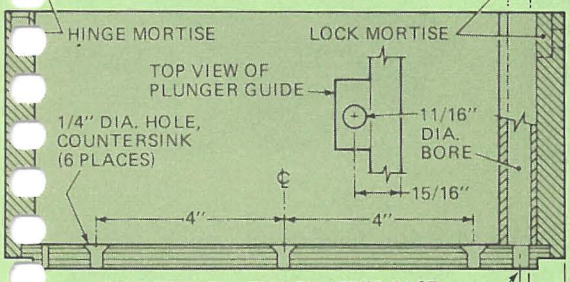
A	1	1 1/8 x 1 5/8 x 7″ cherry (rear female guide)
B	1	7/8 x 1 5/8 x 9 1/8″ cherry (base)
C	1	3/4 x 6 5/8 x 6 3/4″ cherry (center section)
D	2	3/4 x 1 1/8 x 6 5/8″ cherry (male guides)
E	1	3/4 x 1 5/8 x 7″ cherry (front female guide)
F	1	1/2 x 1 5/8 x 6 1/2″ cherry (locking mechanism)
G	4	7/16 x 7/16 x 1/2″ cherry (runner locks)
H	4	7/16 x 1/2 x 10 1/8″ cherry (center runners)
I	3	3/8 x 1 1/8″ birch dowels
J	2	1/4″-dia. x 1/2″ compression springs
K	12	3/4″ No. 6 fh wood screw
L	4	1 1/4″ No. 8 fh wood screw
M	1	1/4-20 x 4 3/4″ carriage bolt
N	3	1/4-20 hex nut
O	2	1/4″ washer



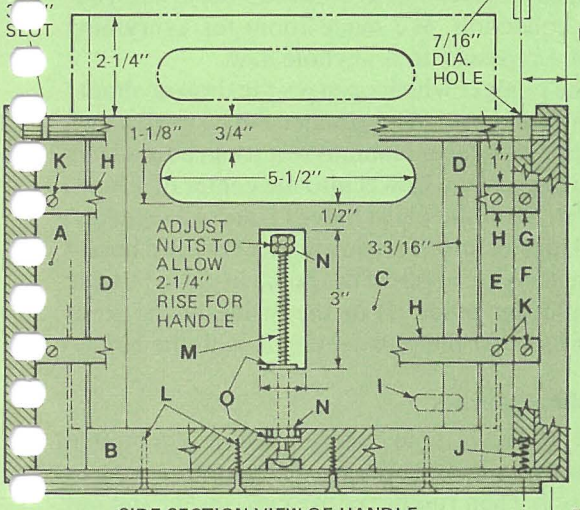
DETAIL 6 – TOP VIEW OF HANDLE CUTOUT



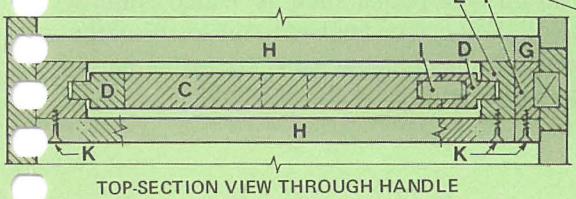
SIDE-SECTION VIEW OF SAW-CASE ASSEMBLY



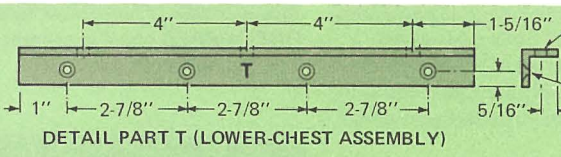
SIDE-SECTION VIEW OF UPPER CASE



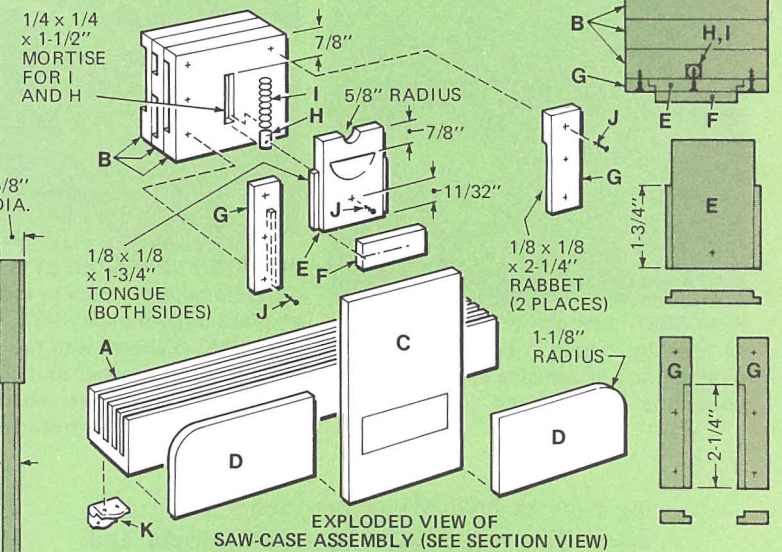
SIDE-SECTION VIEW OF HANDLE



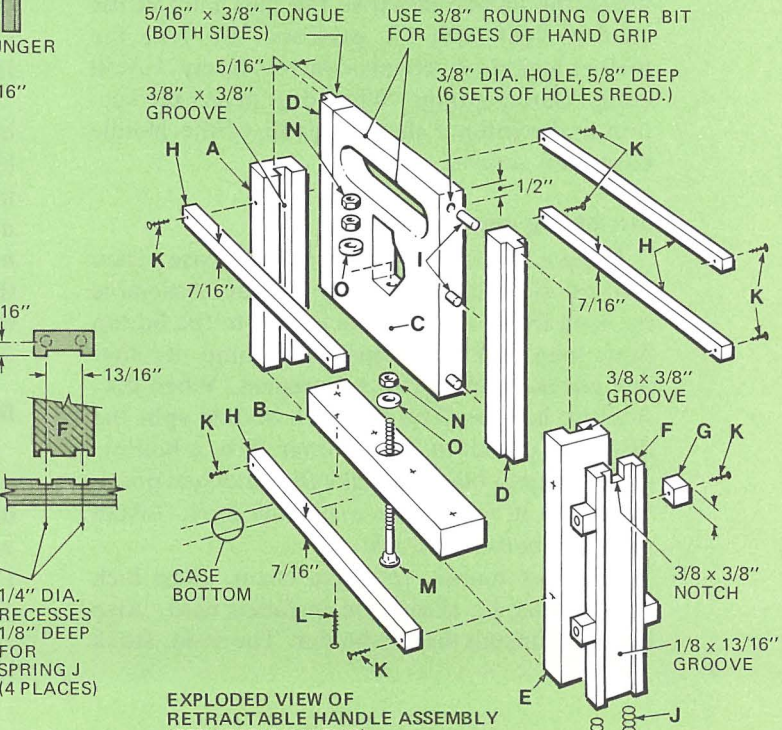
TOP-SECTION VIEW THROUGH HANDLE

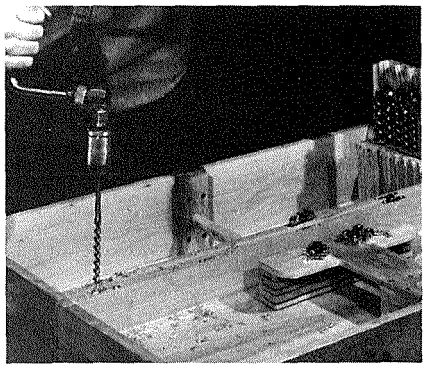


DETAIL PART T (LOWER-CHEST ASSEMBLY)

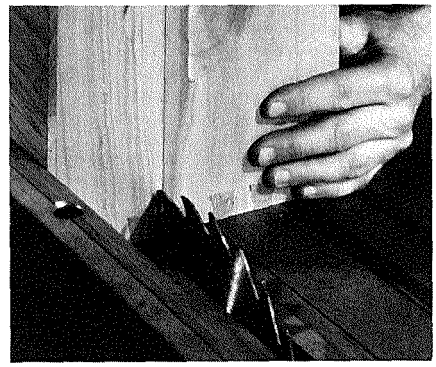


EXPLODED VIEW OF SAW-CASE ASSEMBLY (SEE SECTION VIEW)


5/16″ x 3/8″ TONGUE (BOTH SIDES)
USE 3/8″ ROUNDING OVER BIT FOR EDGES OF HAND GRIP
5/16″
3/8″ x 3/8″ GROOVE
3/8″ DIA. HOLE, 5/8″ DEEP (6 SETS OF HOLES REQD.)
D N H A K 1/2″ 7/16″ I O C
5/16″
13/16″
F
5/8″
1/4″ DIA. RECESSES 1/8″ DEEP FOR SPRING J (4 PLACES)
3/8 x 3/8″ GROOVE
K H B N O D
CASE BOTTOM
7/16″
M L
F G K
3/8 x 3/8″ NOTCH
1/8 x 13/16″ GROOVE
E J
EXPLODED VIEW OF RETRACTABLE HANDLE ASSEMBLY (SEE SECTION VIEWS)



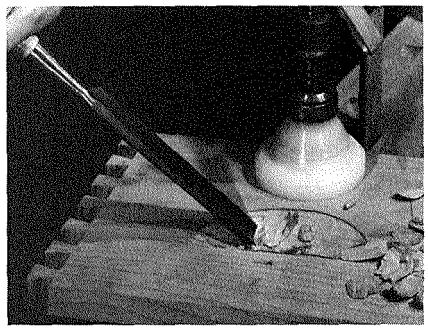
CUT MORTISES for Soss concealed hinges by boring series of holes to proper depth using a bit with diameter equal to mortise width. Clean out waste with chisel.



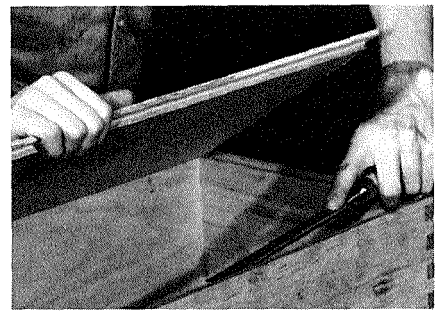
ONCE UPPER chest is assembled, saw lid free, using fence as guide.

MATERIALS LIST—DOLLY

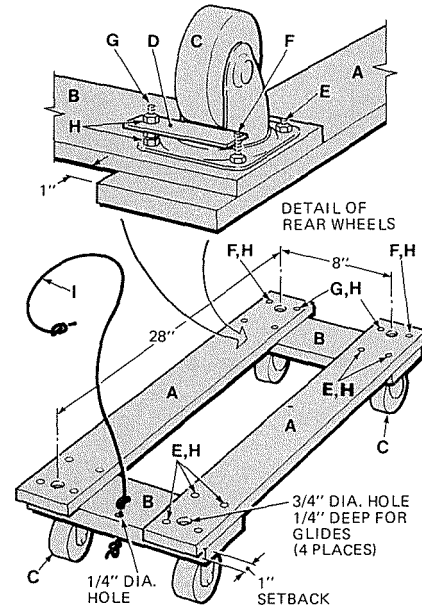
Key	No.	Size and description (use)
A	2	¾ x 3¾ x 32½" oak (long rails)
B	2	¾ x 4¾ x 12½" oak (short rails)
C	4	2" rubber-wheel casters, mounting hardware*
D	2	⅛ x 1 x 4" flat cold-rolled steel (caster locks)
E	12	¼-20 x 2" fh machine screws
F	2	¼-20 x 2½" fh machine screws
G	2	¼-20 x 3" fh machine screws
H	20	¼-20 hex nuts
I	1	¼" x 36" nylon rope



RECESSED chest lifts, drawer pulls can be carved with a gouge. With this tool you can undercut top of concave area to create finger grip. Sand smooth.



INVERTED UPPER CHEST is rabbeted along its bottom edges to receive the plywood bottom piece (M3). For visual clarity, M3 is shown with rabbet facing inward. When assembled, however, rabbeted bottom is reversed to fit into the recess in the top of lower chest. (See drawing.)



ing nails to hold M1 in the rabbet while glue dries. Turn the lower chest half upright and weigh the handle down so the glue joint at the base is tight with the plywood. Be sure the drawer locking mechanism moves freely. Install compression springs. When dry, invert the section and reinforce the glue joint of the handle base with screws.

assembling upper chest half

Make a dry assembly of the upper case. Then coat the side and top joints with glue. Assemble the long frontpiece and backpiece to the lid top first, then join the endpieces. Clamp together and check carefully for squareness. When dry, saw the lid free. The saw kerf should split the dovetails in half at each corner. Use a hollow-ground planer blade to make the cut when possible since it will leave a narrow kerf. Install plywood bottom M3 last.

The Soss hinges, retaining chain, chest lock and top handle should be installed next. Also build and install the sawholder. The ¼-in. stock can be planed down from ½-in. stock—or ordered already planed. Glue up the retainer block (B) from smaller stock. Size the slots to suit your saw collection. We made room for everything from a crosscut to a keyhole saw.

The plunger which engages the drawer should be installed next. The plunger can be turned on a lathe from steel or aluminum or it can be made by inserting a ⅜-in. dowel into the center of a ⅝-in. dowel. With the chest halves fastened together, mark the location for the plunger hole and bore it through to the depth of the notch in piece F. Glue the plunger guide (I) to the inside of the front board so that the plunger aligns with the holes.

finishing touches

Personalize your chest with a decorative medallion or initial inlays. Afterwards, stain as desired. Then rub the entire case inside and out with an oil-type polish such as Watco Natural Finish oil. Felt can be applied to the inside of the drawers. Complete your case by installing an engraved nameplate on the sawholder.

15 quick home repairs

■ HARSH WINTER elements and time combine to work their destruction on your house and property. Spring is just the time to thoroughly check your home and equipment for needed repairs provoked by fluctuating temperatures.

Blacktop driveways, for example, can become an eyesore when the freezing-thawing action of water that's seeped into hairline crevices spreads them into gaping cracks. Oil, grease and coolant from your car add to the problem.

The list of outdoor repairs your property might need could seem overwhelming. But repairs made in the spring will help you enjoy the summer—and prevent more expensive repairs later. Check your roof for damaged shingles and gutters. Make sure that putty around windows has weathered the season and that stored screens are in shape. Here are 15 problems that you may encounter, along with tried-and-true solutions.

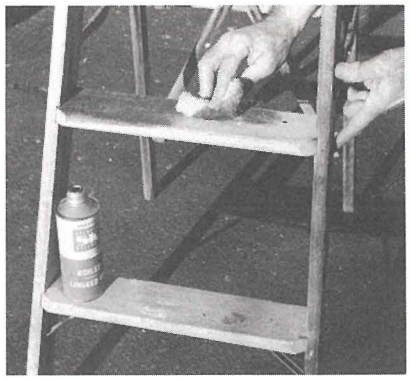
By ROSARIO CAPOTOSTO

1 **SEALING** driveways starts by cleaning oil-soaked spots with a stiff brush and driveway cleaner.

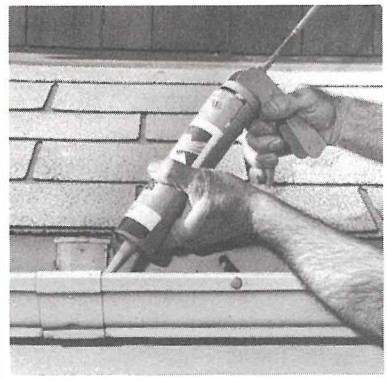
THOROUGHLY hose off the solution with a fine, hard stream of water. Brush when dry.

FILL AND LEVEL shallow depressions and small holes with an asphalt driveway patch mix. Tamp it thoroughly into the holes and trowel it smooth, removing excess material.

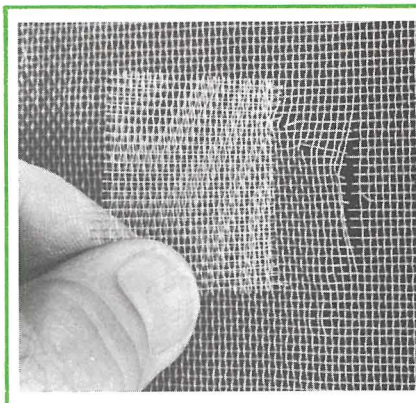
USE AN APPLICATOR with a brush on one side and a squeegee on the other. Spread the sealer with the squeegee, then brush the coating smooth and free of overlapping ripples.



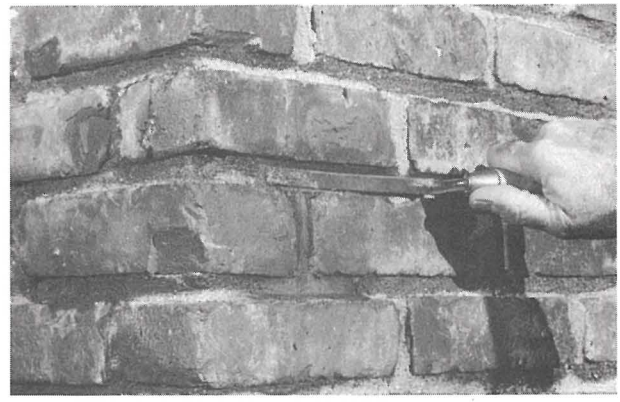
2 **WOOD LADDERS** should never be painted. The coating could conceal rot or contribute to its development. Instead, apply a coat of boiled linseed oil at least once a year.



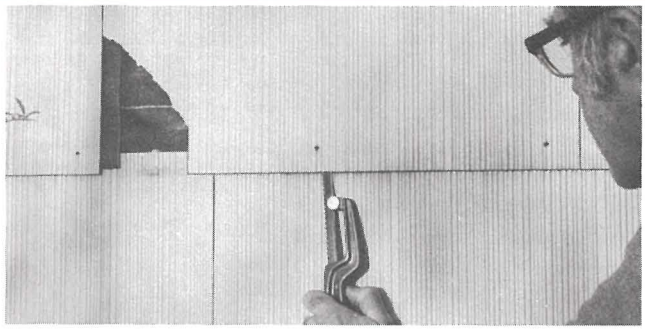
3 **SLIP-FIT** gutter-joint fittings often develop leaks. Clean and dry problem joints. Then apply a bead of butyl rubber caulking along all edges on the inside of the fitting.



4 **EASILY REPAIR** holes in screens with patches you can buy at hardware stores. A patch consists of screen material which has hooked ends on two sides. Simply press hooks through the screen.

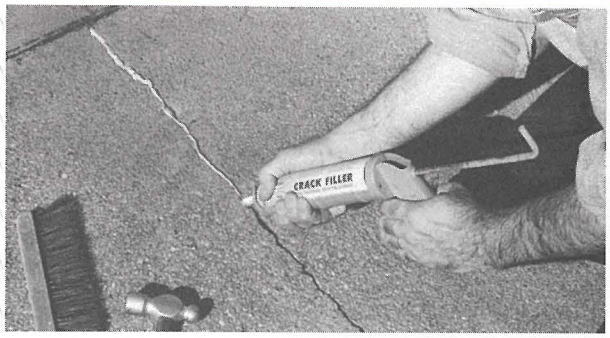


5 **LOOSENED,** crumbling mortar joints in brick can let moisture penetrate. Use a chisel to remove old mortar to a 1-in. depth or until you reach solid mortar. Refinish with fresh mortar. For a more lasting joint, break off mortar around brick's corner and form a T- or L-shaped, interlocked joint. Clean joint with an old paintbrush or by blowing into it (wear goggles), then dampen brick so moisture from new mortar won't be absorbed. Press mortar into vertical joint, then horizontal one with a joint-filling tool (shown). Keep moist for a few days by sprinkling with water.

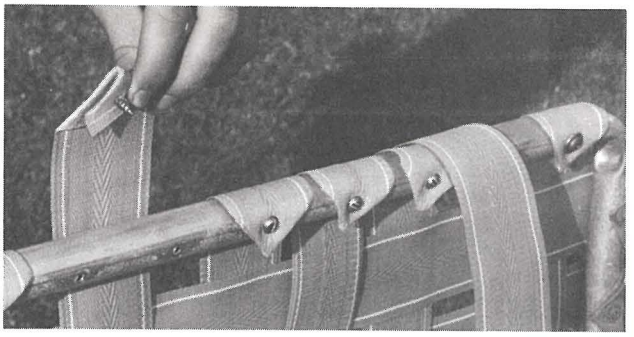


6 **IF YOU** try to remove a broken shingle by prying, you may damage the ones above it—particularly when working with asbestos shingles. For good results, try cutting through nails with a hacksaw blade. The Stanley Mini-Hack is a good tool for the job. It uses an ordinary hacksaw blade in a handle that allows flush cutting.

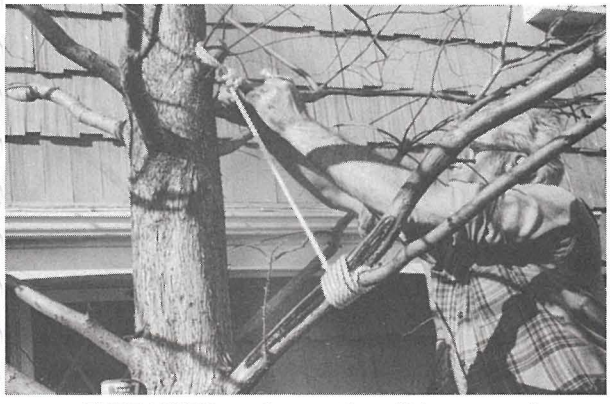
7 **CRUMBLING PUTTY** lets in water which rots the wood. Check bars and mullions and use a chisel to remove old putty. Heat from a soldering iron will soften stubborn spots. Let damp wood dry, then brush on linseed oil to seal wood. Roll a ball of putty in your hands to form a long strand. Press in place with the tip of a flexible putty knife, then draw the knife lengthwise across the frame to form a tight triangular bead. Allow one week before painting.



8 **SMALL CRACKS** in concrete cannot be patched by simply adding cement. Heaving will break it. Use a flexible crack filler containing butyl rubber which remains intact when joints expand and contract. One product is Campbell Krac-Kalk; one cartridge of it seals about 25 ft. of cracks ¼ in. wide by ¼ in. deep. Use a chisel to remove loose particles and clean before applying.

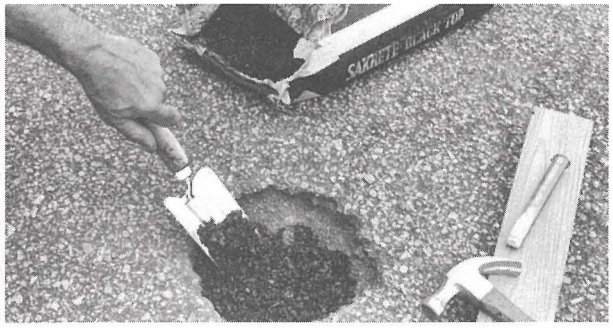


9 **FIX** a plastic-webbed lawn chair with webbing in 38-ft. rolls. Measure between opposing screw holes on the frame, add 3½ in. and cut webbing. Fold one end over at 45° to form a triangle, then fold again dividing triangle in half. Fasten this end to frame with a screw. If hole is stripped, use a heavier self-tapping screw. Repeat the procedure on the other end of the webbing.



10 **TREE LIMBS** are frequently split in severe storms. When this happens, don't be quick to amputate. Open the split and liberally coat exposed wood and bark edges with tree wound paint. Tie the fracture tightly and secure to a higher branch.

11 **LEAVES** and other debris can clog downspouts and cause several problems. Backed-up water will overflow gutters, damaging plants, eroding topsoil, staining the house or leaking inside it. A long gutter filled with water and weighing several hundred pounds can pull away from the house. Install 3-ft. lengths of aluminum-mesh leaf guards to keep out debris. The lengths should overlap about 1 in.

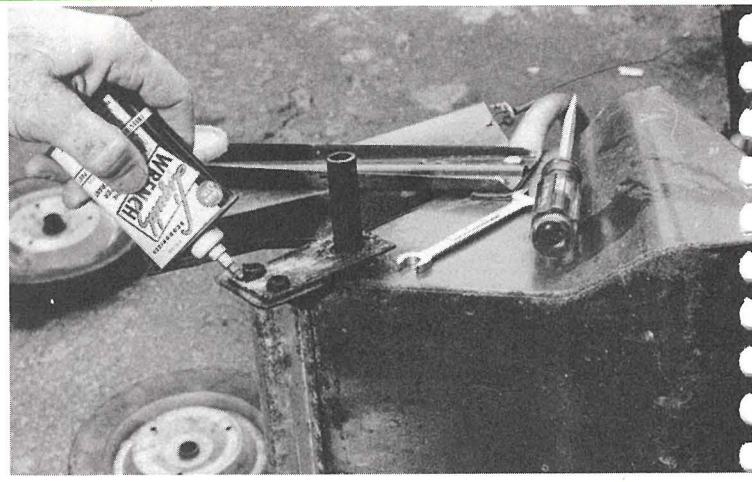


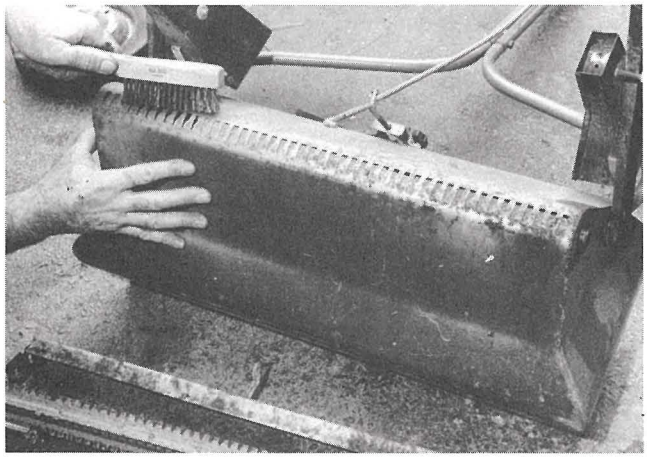
12 **YOU CAN** make a lasting pothole repair. To lock in the patch, undercut the hole with a chisel so it's slightly larger inside than at the top. Clean out all loose particles, then fill hole with ready-mixed blacktop material. It should project slightly above the surrounding surface. Use the end of a 2x4 to tamp firmly into hole. Or place plywood over the mound and drive a car over it several times.

13 **REPAIR** a large gutter hole with a metal patch and asphalt roof cement. Sand and clean the damaged area; apply a liberal coat of roof cement. Cut a piece of thin sheet metal (galvanized or aluminum), coat bottom with cement and lay it in place over the hole. Apply additional cement around the edges.

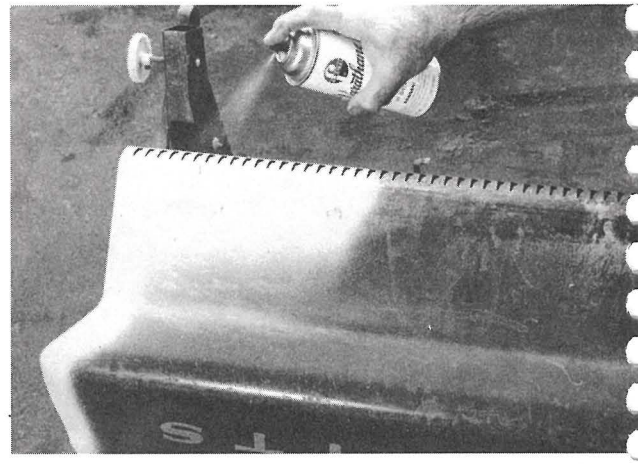
14

STRONG FERTILIZERS tend to corrode lawn spreaders. A thorough washing after use could add years of service to their life. To get your spreader back in shape, first disassemble to thoroughly clean the parts. Use penetrating oil to loosen badly corroded bolts. This will permit you to take apart the hopper and deflector bar. Tap the bolts with a hammer and apply more oil if necessary as you work to free the bolts from the spreader parts.

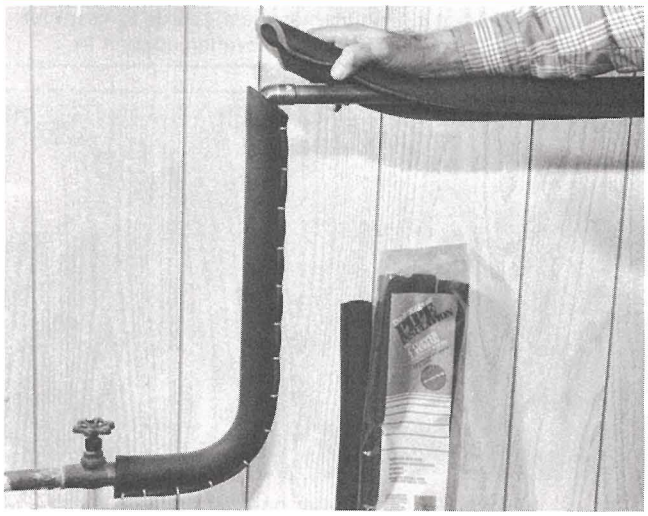


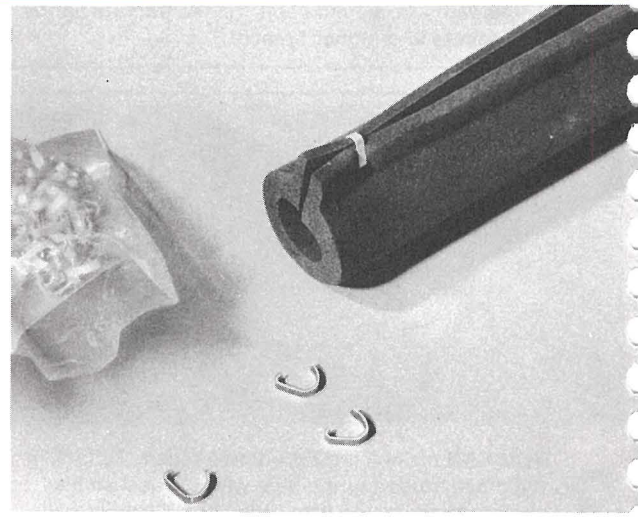


SECOND, use a wire brush to remove loose scale, then sand the rough spots down to the bare metal. Treat the hard-to-reach spots with rust-removing chemicals.



THIRD, apply rust-inhibiting plastic paint such as Flecto's Varathane, protecting axle ends from paint. Always keep axles and wheel hubs oiled.





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COLD-WATER pipes can sweat when water condenses on warm, humid days. Eliminate by covering pipes with insulation. Do-it-yourself foam pipe insulation made by Armstrong Cork Co. is flexible, durable and easily cut with scissors to make snug-fitting mitered corners at the bends. A pack containing 13 ft. of insulation costs about $6. Special metal clips are used over the insulation's flange to close the seam as shown. Clips are supplied with the insulation and should be applied every 2 in. along the run.

How to beat rust and corrosion

Staying ahead of rust and corrosion around the house, shop, yard and car can be a real challenge. There are many products as well as homemade recipes to help

By ROSARIO CAPOTOSTO

ALL COMMON METALS are derived from oxides which are processed to reduce them to a usable state. From that moment on, nature goes to work slowly and steadily converting some of the unprotected metals back to their original forms. This usually occurs through a complex electro-chemical reaction between the metal, water and air. The result is corrosion—which exacts a costly toll around every home.

In the early stages, corrosion may be only unsightly, but if allowed to continue unchecked, it can cause thinning, cracks, holes and general structural failure of metal, resulting in serious safety hazards. For example:

- A crack in an auto floor could lead to carbon monoxide poisoning.
- Failure of a ground-wire clamp in a home's electrical system could cause a serious shock.
- Steel fasteners in a step ladder could cause a fall if they have rotted.

There are four basic types of corrosion: galvanic, crevice, pit and stress.

Galvanic corrosion occurs when two different metals come in contact with each other. This sets up a weak electrical current flow that results in disintegration of the metals. When a bimetal combination cannot be avoided, a coat of paint between the two will restrain the formation of rust. Some common combinations which promote galvanic corrosion include the fastening of brass or copper items with steel bolts or screws, or the combination of copper rain gutters with aluminum or steel downspouts.

Crevice corrosion results when a portion of metal is covered by dirt, a gasket, bolt or screw heads and the like and exposed to a corrosive environment, like wet leaves piled up in a rain gutter, for example. Also, moisture-trapping cracks or peeling in the undercoating of a car quickly promote corrosion, particularly in areas where salt and calcium chloride are used on roads to melt ice and snow. Frequent hosing of the underside of the car will forestall rust. Drive slowly and repeatedly over a garden hose which has many small holes.

Pit corrosion results when small nicks and chips expose bare metal. This occurs most frequently in auto bodies, which are constantly struck by minute particles of debris. To prevent the corrosion from spreading, use a small grinder with a pointed stone to remove all traces of the rust. Then spot-finish with touchup paint or lacquer. Auto-body corrosion is particularly prevalent along seacoasts where the moist air is laden with salt. Frequent washing and waxing is the best protection.

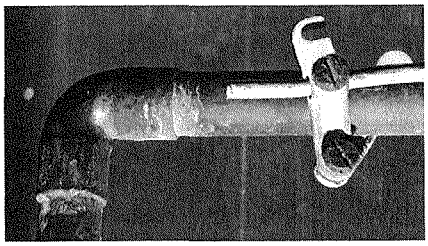
Stress corrosion occurs when a metal that was bent or stretched in manufacture is exposed to a corrosive environment. A crack at the point of stress usually occurs. Certain combinations of metal and environment are especially susceptible. Whenever possible, avoid the following: aluminum alloys with salt water; copper, brass and bronze with ammonia; plain steel with ammonium nitrate fertilizers; stainless steel with salt water.

The best precaution is to seal out the corrosive environment with paints, lacquers or varnishes, inhibitors, greases, oils and waxes. There are many good paints available, some of which contain special rust inhibitors. The most important parts of any paint job are surface preparation and the application of a suitable primer.

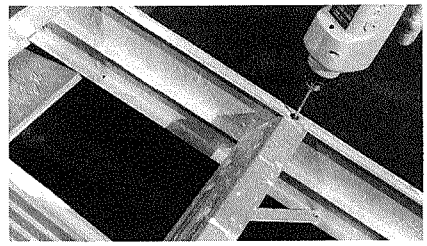
To prepare the surface for painting, scrape and wire-brush or sand to remove any loose scale and rust, as well as loose paint, until the surface is sound. Then apply a primer which is specifically designed for the surface to be painted. While some products claim one-coat rust prevention, one coat of paint over a rusted surface gives only a short-term solution. For lasting results, you need three steps: surface prep, primer and the topcoat.

Clear lacquers and varnishes protect metal without hiding the original finish. Copper and brass can be polished to like-new condition and

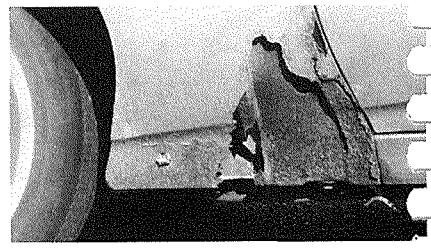
WHERE TO CHECK FOR RUST



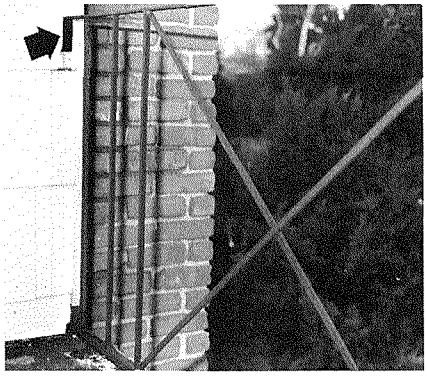
FAILURE OF rust-rotted clamp screws on grounding wire will soon render protection ineffective and create a hazard.



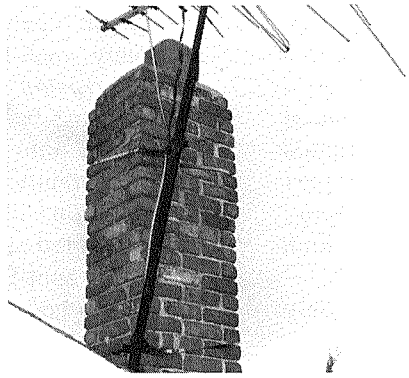
REPLACE rusted rivets in metal ladders with nonrusting kind. Use your drill and a twist bit to remove the old rivets.



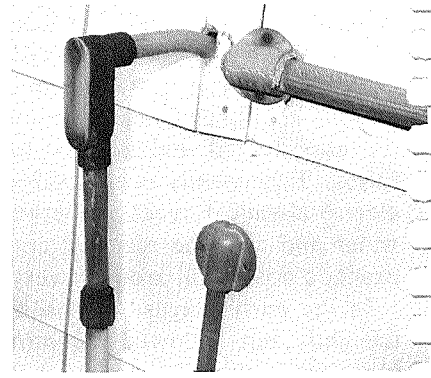
A THOROUGH undercoating when a car i new—plus periodic touchups—prevents body rust, which diminishes resale value.



GUARD RAIL offers little protection because steel lagscrews which fasten it to wall have nearly rusted away. To solve problem, railing should be moved slightly, refastened with galvanized screws.



ANTENNA masts and clamps will soon look like this if the components are poorly galvanized or made of plain steel.



ELECTRICAL conduit in condition show is a menace. Check all fittings and replac any that show signs of corrosion.

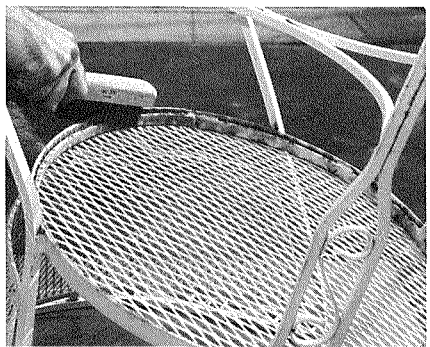
QUICK RUST CLEANUPS AROUND THE HOUSE

FLEXIBLE sanding wheel in a drill quickly removes rust and gets down to bare metal of badly rusted steel gutters.

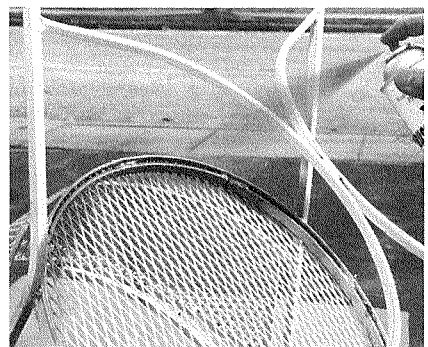
A COAT of quality metal primer is a must for a job that will last. Or, use a new water-based primer to speed up the task.

ONCE THE JOB of sanding, priming an topcoating is done, the old gutter installation looks like new.

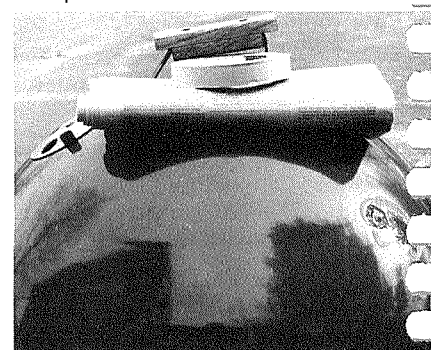
A STIFF wire brush can't be beat if you have to remove rust scale from small, tight areas such as this chair.



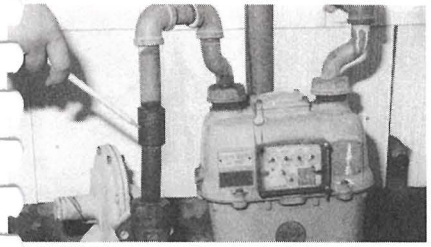
SPRAY PAINTS, better suited to painting intricate shapes, assure complete coverage even in tight spots.



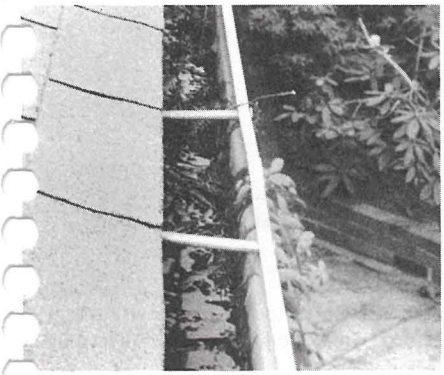
IF LEFT untreated the chipped enamel surface of this barbecue will accelerate the spread of rust.



KEEPING DOWN CAR RUST



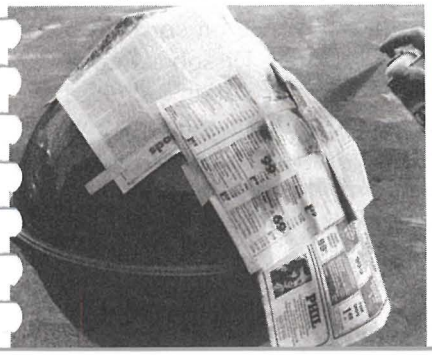
SLIPSHOD gas-meter installation joins galvanized and nongalvanized pipes. Galvanic action may create leaks.

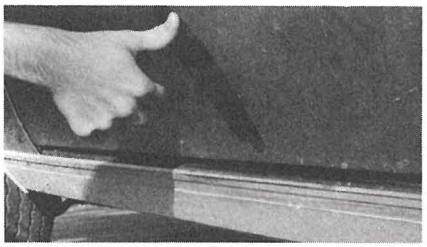


POORLY maintained rain gutter will develop crevice corrosion and soon rot. Gutters should be dry when it's not raining.

TO APPLY coating in hard-to-reach places (such as obstructed side of garage-door roller), use oil in spray can.

USE high-temperature-resistant enamel to touch up damaged spot. Mask surrounding surface with newspaper.



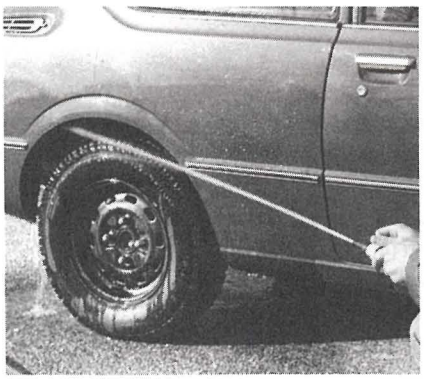


WASH CAR frequently to remove road grime, which contains rust-promoting agents.

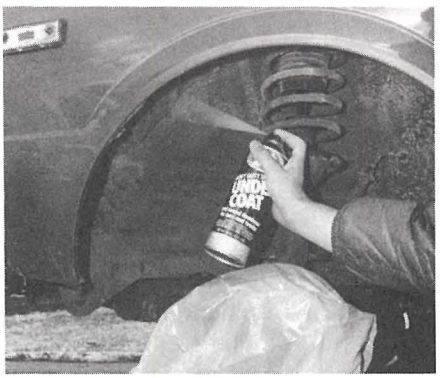
SMALL HAND grinder with conical stone is perfect for removing rust from nicks and chips prior to touchup painting.

SURFACE condition shown can be a result of infrequent washing and waxing, particularly in coast or industrial areas.

WATER trapped in car doors (arrow) rots metal. Remove plug to speed drying, check doors often for clogged weep holes.

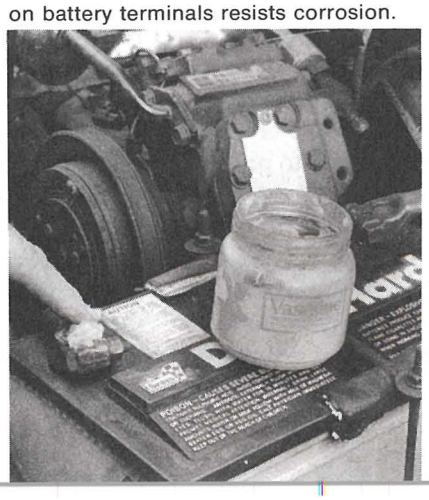


WHEEL WELLS, car underparts should be washed frequently, especially where snow-melting chemicals are used.



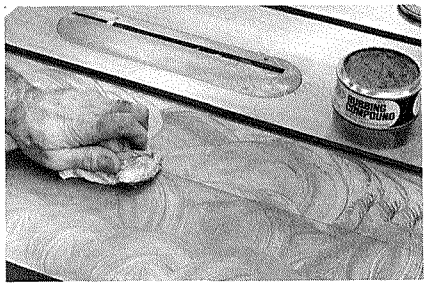
SMALL CRACKS, peeling in undercoating cause crevice corrosion. To remedy, cover wheel with plastic. Then patch affected areas with a spray undercoat.

HEAVY COAT of grease or petroleum jelly on battery terminals resists corrosion.

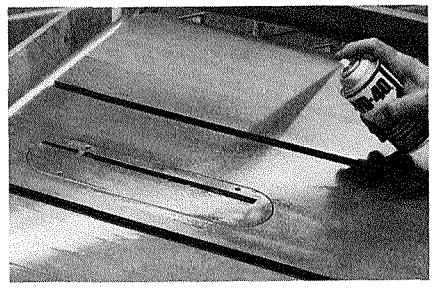


SEVERAL thorough waxings per year will protect car finish against deterioration.

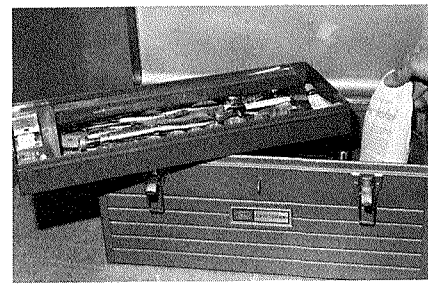
STOPPING RUST IN SHOP AND YARD



USE AUTO rubbing compound to remove rust, stains without marring saw table.

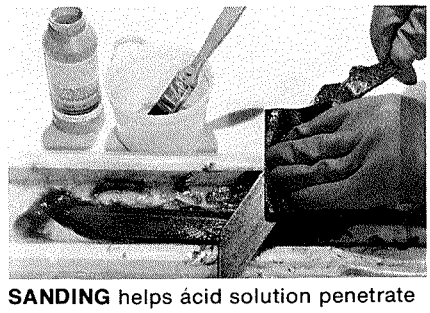


A MOISTURE-DISPLACING coating prevents rust, provides low friction surface.

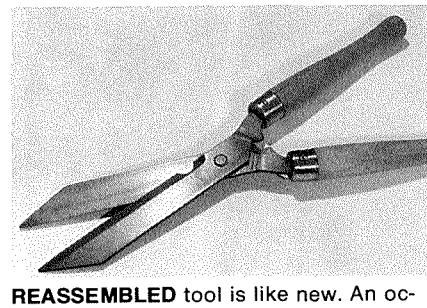


PLACE A BAG of desiccant in auto toolbox to keep tools dry and rust free.

BRUSH is used to apply remover with disassembled tool in plastic container.



SANDING helps acid solution penetrate into rust. Rubber gloves are a must.



REASSEMBLED tool is like new. An occasional wipe of oil will keep it looking fit.

kept that way by spraying on a clear finish. Or, if the object has tarnished to a stage that is desirable, a clear coating will keep it that way. Aluminum that corrodes into a dull, whitish film that dulls its surface can be cleaned and then coated with clear lacquer or varnish.

Inhibitors are chemicals which are added to an environment to make it less corrosive, or applied to a metal to protect it from the environment. Moisture-displacing sprays such as WD-40 are useful for protecting bare metal objects which cannot be painted, such as tools and machine surfaces. The most familiar use of inhibitors is in the cooling system of a car. Most antifreeze and coolant preparations contain inhibitors to protect the engine cooling system from corrosion, but, in time, replenishment is necessary.

Another type of inhibitor consists of a bag of silica gel pellets. Placed in a toolbox, drawer or the like, this substance absorbs moisture to protect the contents from corrosion.

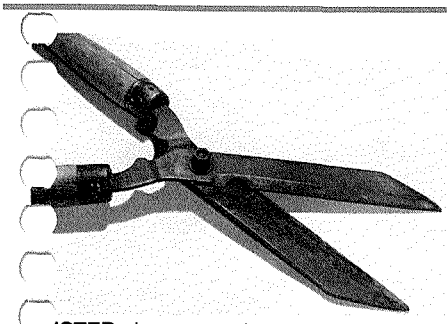
Rust, tarnish, and other corrosion can be removed with chemical preparations, providing the object is still sound. There are a number of corrosion removers on the market. Usually consisting of an acid solution suspended in a thick jelly-like liquid, the material dissolves corrosion. Upon testing several rust removers, it was found that in order to get really good results on badly rusted steel, it was necessary to go a bit beyond the printed instructions.

Simply brushing the material onto the rust in a thin coat didn't do much. Instead, we fashioned a shallow wood trough and lined it with plastic sheeting to keep the solution in constant contact with the rust. Occasional sanding with wet-or-dry abrasive paper during the soaking also proved effective.

Other cleaners remove corrosion or tarnish on aluminum, copper, brass, silver and other metals. They require less effort because they corrode less than iron or steel.

There are homemade preparations for removing corrosion. The following are from the U.S. Department of Commerce, National Bureau of Standards' Consumer's Guide on corrosion:

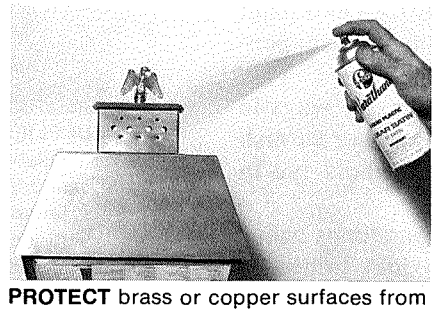
- **For rusted iron or steel:** Dissolve four teaspoons of citric acid (or sour salt) in one quart of water. Carefully add small amounts of household ammonia to this solution, mixing thoroughly. *Very carefully* sniff the mixture after each addition. After the first few additions of the



RUSTED shear was chosen as a good candidate for testing a rust remover.

FIRST, all grime and oily residue was removed using lacquer thinner.

ALUMINUM JELLY'S thick gel stays put, even on vertical surfaces.



PROTECT brass or copper surfaces from corrosion with clear polyurethane finish.

ammonia, you will not smell an ammonia-like odor from the mixture. Keep adding small amounts of ammonia and mixing until the mixture just starts to smell of ammonia again. Add more water to bring the volume of the mixture up to two quarts.

Put the solution in a fire-safe glass or enameled container. Place it on the burner of the kitchen range and heat the liquid to a temperature of about 150 to 160° F. Maintain that temperature and soak the rusted object. Check from time to time by removing and rinsing with clear water. For heavy rust, the procedure may take several hours.

For small spots: combine 2 oz. of cream of tartar and 1 oz. of oxalic acid (caution: poisonous). Moisten the rust spot, apply the powder and leave on for 10 minutes. Rinse thoroughly with water; then dry it quickly.

- **For aluminum:** The black or dark brown that occurs in aluminum pots used to cook eggs or to heat certain types of tap water can be removed easily by cooking sour foods such as tart apples, sauerkraut, or tomatoes in the pot.
- **For copper, brass and bronze:** Before attempting to clean copper, brass or bronze, remove any lacquer with a lacquer thinner and wash with warm water and detergent. After rinsing and drying, try one of these methods to remove the tarnish: Mix equal parts of salt, flour, and vinegar and apply the mixture to the metal with a dry cloth. Or, moisten the tarnished area with water, cover with salt and rub vigorously with a lemon slice. After removing the tarnish, wash the metal with warm water and detergent; rinse and dry. To preserve the gleaming finish, apply a coat of lacquer. Do not lacquer copper-clad cooking utensils.
- **For silver:** As with other metals, silver can be cleaned with commercially available preparations. However, if you have a silver item which has an intricately inscribed design, the following procedure is suggested: Wrap the entire object in aluminum foil, making a few cuts in the foil to allow liquid to flow in. Place the wrapped object in a large glass, enameled or stainless steel pot that can be safely placed on the stove. Fill the container with a solution of water and bicarbonate of soda (4 to 5 tablespoons per quart of water) and simmer for 30 minutes. Remove the foil, and rinse and dry the silver thoroughly.

Make your own paint remover

Paint dealers probably won't tell you these secrets, which cut the cost of removal materials so low there's no profit in selling them

By CHARLES RHINE

NO MATTER HOW you look at it, stripping off old paint to get the wood ready for a new paint coat is a messy job. But it's getting to be expensive, as well.

One of the best and least expensive ways to strip a large surface of old, hard paint or varnish is with a strong solution of household lye in water.

If mention of the word lye (sometimes called caustic soda or sodium hydroxide) brings to mind some great danger, it shouldn't. Anyone who is used to handling the common brands of drain and oven cleaners won't have any trouble. Most of these items are lye.

The cheapest way to remove paint is to get bulk quantities of the oven and drain cleaners from a chemical supply house, or buy smaller containers of plain lye at your local grocery or hardware store.

Even the more expensive chemical-solvent type paint removers are not entirely safe. Most of them contain methylene chloride and other solvents in containers aglow with warning notices.

Lye has no toxic fumes. It's nonflammable, so it won't explode in your face if you get near a flame. Do be careful not to splash it on your skin, though. It can give a nasty burn. Flood with water immediately.

THE SUPPLIES you need to make paint remover are readily available. They include: lye or TSP as a stripping agent, laundry starch for thickening the solution, paint scraper, laundry bleach and a metal bucket for mixing your solutions. A scrub brush with natural bristles or cotton mop applies the remover.

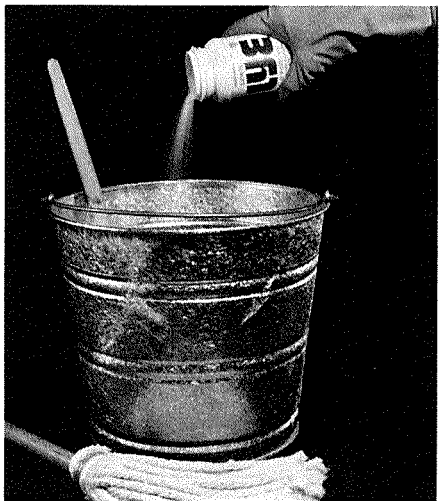
For insurance, do wear rubber gloves, long sleeves and eye protection; keep a garden hose or several buckets of clean water handy and work carefully. If the lye solution does get into the eye, flush continuously with clear water and get immediate medical assistance. Also be sure you don't breathe any of the dust when you're pouring lye out of the can.

Another inexpensive paint remover is trisodium phosphate or TSP. It is sold by paint and hardware stores for heavy-duty cleaning.

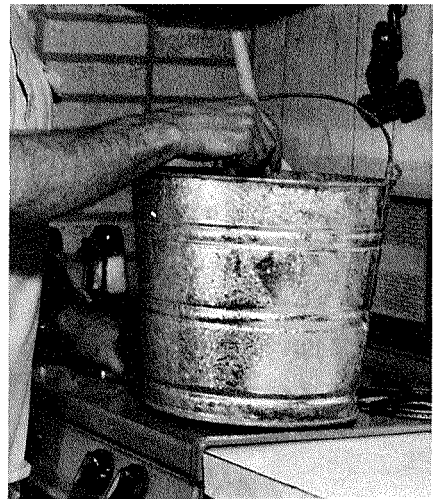
Make a stronger mixture of TSP for removing paint than you would for cleaning. Heat it to near boiling and presto, you have the poor man's answer to the rising cost of paint removers.

TSP is not as caustic as lye and it takes a little longer to do the job. However, handle it with the same precautions as you take with lye.

ALWAYS POUR the lye into the water. *Don't* pour water into lye.



STIR AS YOU add lye; then get it piping hot. Remover won't work below 65°F.



WHEN WORKING outdoors, a portable gas heater keeps the solution hot.

These alkaline solutions are fine for stripping paint from metal, as well as wood. Just don't use them on aluminum. They're also among the few things that will remove old milk paint or casein-type finishes. However, the solutions have no effect on some of the modern finishes based on urethane, alkyd or epoxy resins.

The biggest problem using a water solution to remove paint occurs when you try to strip furniture or veneer put together with glue that isn't waterproof. You could wind up with a pile of furniture parts. This is okay if the piece needs re-gluing anyway. Replacing buckled veneer, however, is a rather difficult task.

If the joints are sound but the glue is water-based, strip a small area at a time and wipe each section dry as you finish it.

Alkaline solutions will darken the color of the wood. They also raise the grain of the wood, so you'll have to go over the entire piece with fine sandpaper. Lye will eat up wood if left on the surface long enough, but this is no problem in the short time it takes to remove paint.

Finally, because the water soaks into the wood and joints, it takes several days to dry. Wait until then to refinish the piece.

These strong alkali strippers must be mixed in a steel or iron pail. *Never use an aluminum one* because it will deteriorate. The heat produced by the reaction of lye and water can also shatter glass, stoneware or ceramic containers. Plastic won't do because it will melt with the heat.

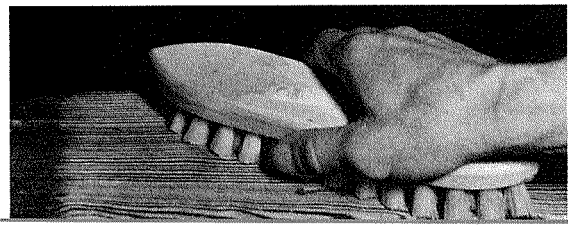
An enamel-coated garbage pail works just fine. A galvanized bucket will do, but in time the solution will dissolve the zinc coating.

Don't fill the bucket more than about half way, so the solution doesn't boil over the edges.

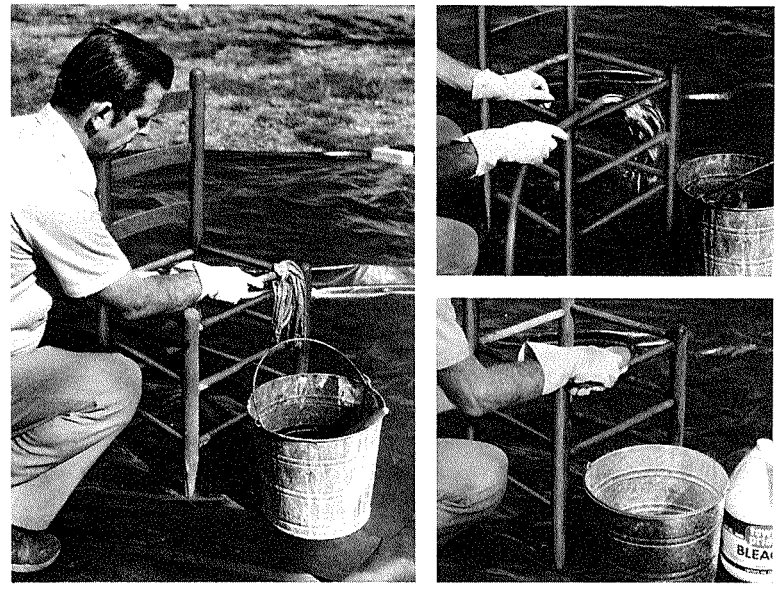
Most important: Always pour the powdered alkali into the water, not the other way around.

LAYERS OF TOUGH, hard paint or varnish seem to melt under the action of a hot lye solution and scraper.

BRUSH ON some full-strength laundry bleach if you want to restore the wood to its natural color.



Three easy steps to furniture stripping



FIRST, MOP ON a hot lye solution (above, left) with a mop attached to a broom handle or cotton rags attached to a stick. The sun helps the lye work; plastic protects the grass. After varnish softens to the wood, it washes off easily with a garden hose (top, right). Laundry bleach can be used to restore the wood color (bottom, right). Always flush thoroughly with water.

This is particularly true for lye, which may otherwise spatter. Use a wood stick to stir the solution as you pour.

To thicken the solution so it won't run off the surface, add regular household laundry starch. The gel-like paste that's produced will even cling to vertical surfaces.

When mixing lye, start with lukewarm water. Lye dissolves too slowly in cold water, but reacts violently in hot water. Mix TSP, on the other hand, with hot water.

I use one 13-oz. container of lye to 3 qts. of water. Some experts recommend a stronger solution.

Start by mixing the lye in a quart of lukewarm water. In another container put 2 qts. of cool water and stir in four heaping tablespoons of laundry starch. Then pour the lye solution into the starch solution while you stir.

Use about a pound of TSP to a gallon of hot water. Then stir in about a cup of starch to thicken it.

Both lye and TSP work best when the solutions are applied piping hot. Don't even try to do the job if the temperature of the solution is below 65° F. For ideal results, heat the mixture on a stove but do not bring it to a boil as minute particles of caustic soda may be entrained in the

steam and irritate the eyes and respiratory passages. Work in the sun. If the solution cools, reheat it.

Caution: A hot 15 percent lye solution can destroy the cornea instantly. Wear goggles and adequate protection and have a hose ready.

To apply the solution to the surface, use a scrub brush with natural fiber bristles or a cotton mop.

Don't be stingy when you apply the solution; it's not expensive. Don't let the paste solution dry.

How fast the solution works depends not only on the temperature but also on how hard the old paint is and how many layers there are. Most often the remover will take off two or three thick coats of paint in five or 10 minutes. Every few minutes check the action with a scraper to see if the paint has softened down to the wood. Don't leave the paste on the wood longer than is necessary. If the job is a big one, do it by stripping and rinsing a small area at a time.

For final cleanup, simply hose down the wood thoroughly with water. Any spots of paint that don't wash off can be scrubbed off with steel wool.

Work outdoors on a sheet of heavy polyethylene film. Excess water and lye can be diverted into a drain and the sludge can be rolled up with the film and then tossed in the garbage. Be careful to seal the package, as caustic contaminated articles may burn anyone else who handles them.

When you use strong lye on wood you must neutralize the surface with a weak acid solution before you paint. For example, scrub the piece down with plain vinegar. Brush it into cracks and wood pores and rinse off the water. It's not necessary to neutralize TSP solutions.

Most woods, particularly oak, cherry and mahogany, are darkened by the alkali solutions. However, alkali on some woods, such as pine, maple or birch, produces an antique patina that you may want to keep.

If you refinish the wood with an opaque, colored paint, this discoloration will not bother you one bit. If you want to return the wood to its natural color, however, just brush it down with full-strength Clorox or other liquid laundry bleach. Be sure the piece is rinsed thoroughly with vinegar first to prevent the formation of chlorine gas.

The low cost of using strong alkali to strip paint makes it practical to use on rather large jobs. You can strip the outside of a house that has had many coats of paint. These layers yield to lye with a lot less work than burning and scraping—and there's no fire hazard.

You might take a hint from industrial and commercial refinishers and build your own dipping tank. With it you can strip an entire piece of furniture at one time.

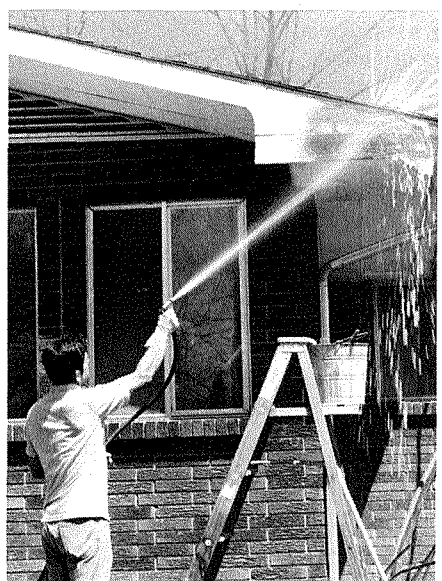
I built mine using a 55-gallon steel drum. The dipping basket is made of half-inch mesh hardware cloth. I raise and lower the basket in the drum by a rope that runs through a pulley. The pulley is attached to an overhead tree limb.

Besides stripping furniture, I have used the rig to strip the varnish from a quantity of used flooring I picked up at a wrecking job. Bricks in the bottom of the basket help sink it in the solution and a wire cloth lid prevents the object from floating to the top. A portable gas heater positioned under the barrel keeps the solution hot.

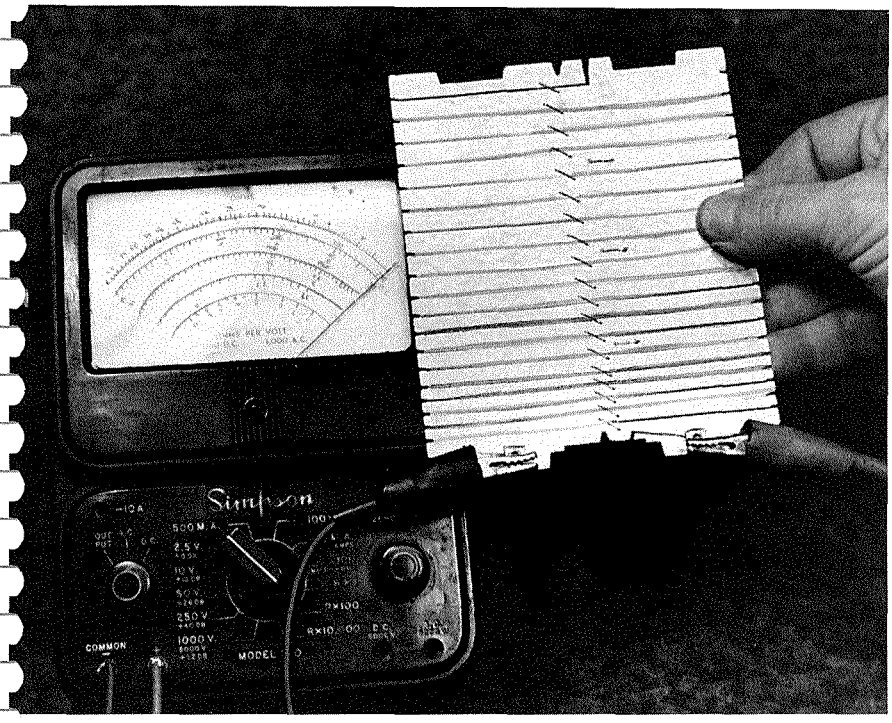
Easy way to handle big stripping jobs

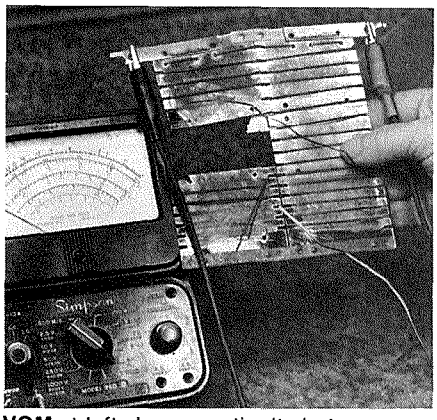
BEFORE repainting house, use long-handled brush and lye to strip old paint.

SOFTENED paint hoses right off to expose wood. Scrub with weak acid to neutralize.



A LYE-DIPPING tank makes easy work of stripping used lumber and furniture.





VOM at left shows continuity but no resistance. Switch should be set on R × 1 scale. Element in photo above has no continuity, indicating a circuit break.

How to test appliances for electrical continuity

By MORT SCHULTZ

■ MANY APPLIANCE REPAIR books and columns suggest that you begin your repairs by testing continuity. Just what *is* continuity and how *do* you test it?

Continuity, according to professional Ed Jacek, who owns City Wide Radio and Appliance Service Co. in Fort Lauderdale, Fla., "is the most important, yet easiest, way of troubleshooting an appliance.

continuity defined

More specifically, continuity is a term for a continuous (unbroken) circuit. If current through a circuit flows from points A to B, the circuit from A to B has continuity.

If current introduced in a circuit at A does not reach B, the circuit lacks continuity. It is broken (open).

Resistance, on the other hand, is the opposition to the flow of current. It is measured in ohms with an ohmmeter.

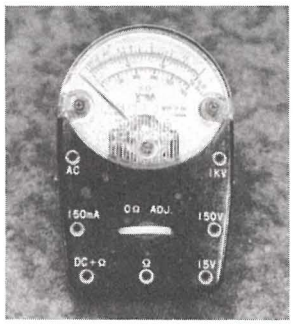
Circuits have resistance and continuity. In some circuits, however, the presence of other than negligible resistance indicates a bad circuit. For example, consider a toaster. Let's call the electric cord from plug to the toaster element circuit A to B, and let's refer to the toaster element itself as circuit C to D.

Circuit A to B consists of copper wire that has practically no resistance to current. When an ohmmeter is connected between points A and B, the scale should read 0 ohms or show only a slight deflection. (In any test for resistance, be sure to first unplug the appliance from the power source and make good metal-to-metal contact with meter leads at the circuit terminals.)

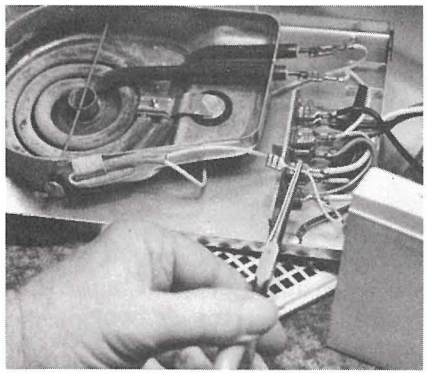
Circuit C to D consists of an element with higher resistance. This resistance is needed to put the element under an electric load, so the element will glow and toast bread.

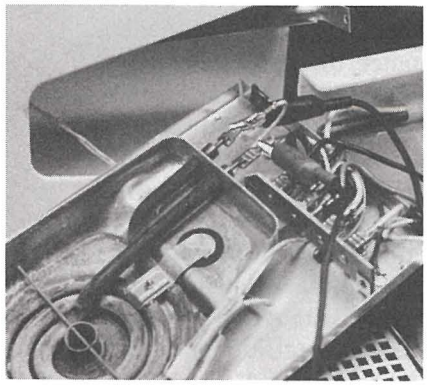
A typical heating element used in toasters and other appliances is made of a nickel-chromium alloy, called nichrome, that has higher resistance to current flow than copper wire. Nichrome is, in fact, referred to as resistance wire.

When testing toaster circuit C to D for contin-

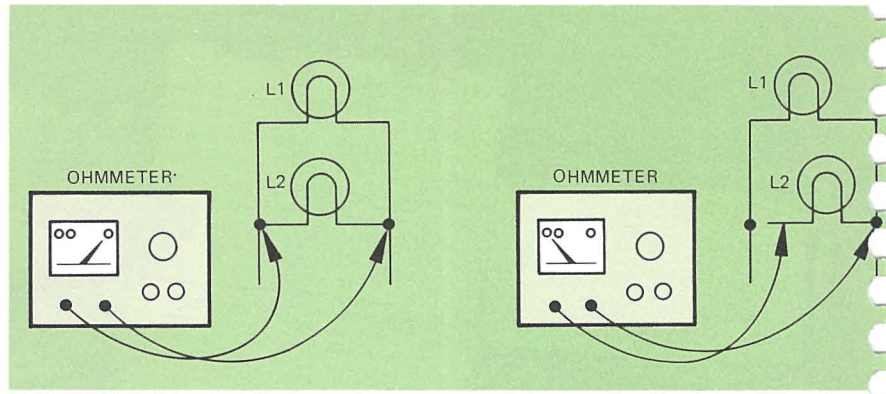


FEATURES determine the cost of a VOM. A meter like the one on top with an R × 10,000 scale can cost up up to 10 times more than the meter below.





THE PROCEDURE diagrammed at the top of the next column is illustrated here. To properly test continuity of the element in the coffeemaker, the circuit is disconnected using needlenose pliers to pull the connector off the terminal (photo, top). VOM leads are then attached to each side of the circuit.



THE DIAGRAM to the left shows the *wrong* way to test continuity of circuit L2. The L1 circuit will affect the reading on L2 since they are connected. To avoid interference from other circuits, always disconnect circuit at some point. Diagram at right shows that circuit L2, when not influenced by circuit L1, is in fact defective.

APPROXIMATE RESISTANCES OF SOME APPLIANCE CIRCUITS

Appliance	Circuit	Approximate Resistance (Ohms)
Automatic clothes washer	Inlet valve solenoid terminals Main motor terminals, high-speed Main motor terminals, low-speed Timer Motor leads	400 0.81 0.75 1050
Blender	Motor, high-speed Motor, low-speed Motor, medium-speed	20 40 30
Dishwasher	Heating element terminals Inlet valve solenoid terminals Main motor leads, "Pump" Main motor leads, "Run" Main motor leads, "Start" Pump motor leads (where pump is separate from main motor)	15 280 6 3 6 6
Electric clothes dryer	Heating element terminals (double-element) Heating element terminals (single-element) Main motor terminals Timer motor leads	15,22 10 2 1100
Electric can opener	Motor terminals	7
Electric coffee percolator	Heating element	33
Electric fry pan	Heating element	50
	9-inch, 2-wire element 5-inch, 3-wire element outer coil-inner coil 9-inch, 3-wire element outer coil-inner coil	30 60-80 40-65
Electric water heater	Heating element, 1000-watt Heating element, 2000-watt Heating element, 4500-watt	60 30 15
Food mixer (hand)held, three-speed)	Motor, high-speed Motor, low-speed Motor, medium speed	40 60 50
Iron	Heating element	12
Refrigerator	Compressor motor terminals "Run" Compressor motor terminals "Start" Condenser fan motor leads Evaporator fan motor leads	2 10 65 50
Toaster	Heating element	12

uity, the needle of the ohmmeter will show a deflection indicating the resistance value of the element (about 12 ohms) if the circuit is not damaged. If the ohmmeter needle swings instead to infinity (∞) or reads 0, the circuit is defective.

using a test light

You can also use a battery-powered test light for testing the continuity of a circuit. The test light is connected between the circuit's two terminals. If the light glows, the circuit is complete. If the light does not glow, there is a break in the circuit. However, a test light cannot measure resistance (ohms). For this, you need an ohmmeter.

An ohmmeter, consisting of the meter, several resistors and a battery or batteries, is normally combined in one instrument with a voltmeter and milliammeter, which measure volts and current, respectively. This is called a volt-ohm-milliammeter, VOM or multimeter.

A typical VOM has switch settings of R×1, R×10, R×100 and sometimes R×10,000. These settings allow you to measure low resistances (0 to 100 ohms), as well as resistances in the thousands of ohms.

Since resistances in appliance circuits are low for the most part, you won't need an ohmmeter with a R×10,000 switch setting. The setting used most often for testing the continuity of appliance circuits is R×1. If the ohmmeter needle shows the presence of resistance, the value of the measured resistance is the reading multiplied by the range switch setting. Thus, a reading of 15 with the instrument set on R×1 would be 15 ohms. A reading of 15 at R×10 would be 150 ohms.

points to remember

1. Because the ohmmeter has its own power source, you must disconnect the appliance from the wall outlet *before* connecting the ohmmeter. The ohmmeter circuit is designed to operate on low voltage. If the higher voltage power source is maintained, the VOM will be damaged.

2. Circuits in an appliance are interrelated. Thus, a circuit lacking continuity may show a positive reading, because the VOM is indicating the continuity of an interrelated circuit. *Make sure this doesn't happen by disconnecting one end of the circuit you are testing and connecting the ohmmeter between the disconnected and connected ends.*

3. When disconnecting more than one wire, mark the wires so they can be reconnected correctly. Wrap masking or adhesive tape around the wire. On this write the designation on the terminal (numeral or letter) from which the wire is taken.

4. Learn to read wiring diagrams. The diagram is a road map to appliance circuits. To test continuity, you have to know where a circuit begins and ends. Determining this by "hand-tracing" the circuit is difficult in an appliance that has many circuits.

5. Before connecting the VOM, set the range switch to R×1. Keep the test leads out of their jacks. The meter needle should be stationary at the infinity mark, which is the "lazy eight" (∞). Most VOMs have a small screw under the needle pivot point for making slight adjustments. A needle that cannot be adjusted or one that is far off the ∞ mark signifies a damaged meter.

6. Plug the test leads into jacks. The red lead is positive (+) and goes into the + jack; the black lead is negative (−), or common, and goes into the −, or COMMON, jack. Touch the ends of the leads together. The needle should move to zero. If the needle doesn't fall on zero, turn the OHMS (Ω) ADJUST knob until it does. This is called "zeroing the meter."

7. When testing the continuity of a circuit supposed to have little resistance, connect the ohmmeter and set the range switch on R × 1. The ohmmeter should read zero, or nearly zero. If the needle swings to infinity (∞) or shows a high resistance reading, the circuit is bad.

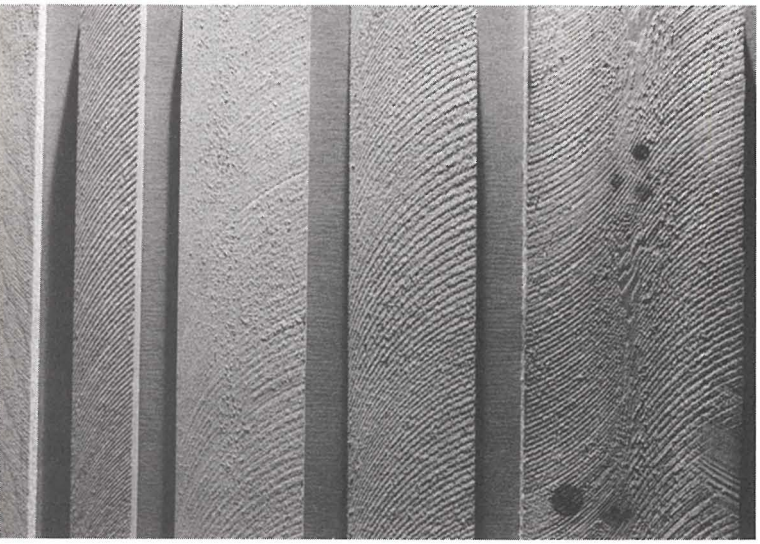
8. To measure resistance, connect the ohmmeter and set the range switch to get a reading—R × 1 for resistances of less than 100 ohms, R × 10 or R × 100 for resistances above 100 ohms.

You should know the specified resistances of the circuit. This may or may not be stated on the wiring diagram of a major appliance. If it is not, or if you are working on a small appliance for which there is no diagram, a letter to the manufacturer should get you this information. When writing, remember to give the appliance model number. The chart on page 120 provides *approximate* allowable resistances of a number of commonly tested circuits.

The ohmmeter should read the specified resistance value of the circuit. If it doesn't, your trouble is confined to that circuit.

9. To protect your VOM, be careful how you store it. Unhook the leads and wrap them around the instrument. This prevents leads from accidentally shorting, which can cause the battery to discharge if the range switch is left on an "R" setting.

Set your saw to cut rough-sawn boards



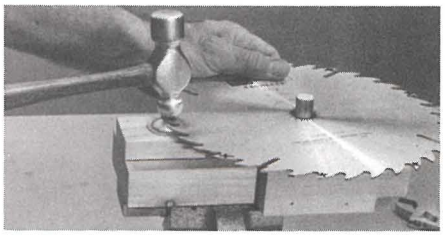
VARIOUS TEXTURES can be created, depending on the set of the teeth.

By JOHN GAYNOR
and ROSARIO CAPOTOSTO

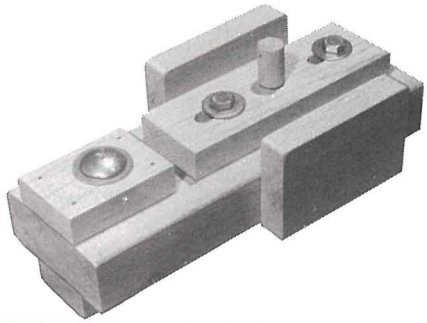
■ THIS JIG LETS you set your own table-saw blades to rip textured wood. A 10-in.-diameter blade that fits a ⅝-in. arbor fits on the jig and rotates so any tooth can be positioned on the anvil, with 1/16 in. projecting past the anvil.

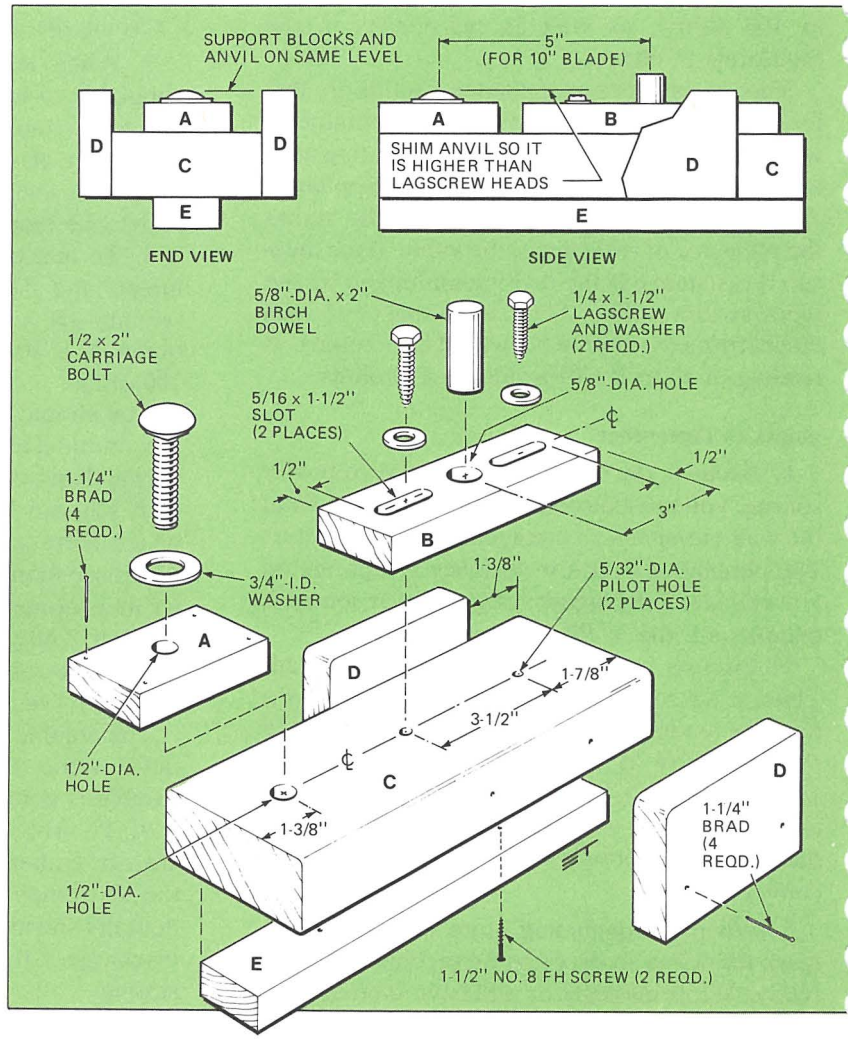
Use a ball-peen hammer for extra set. Every second tooth set to left and every second tooth set to right is set an extra amount. Leave the other teeth as is to create a skip-tooth blade. (One of our 26-tooth blades was set by tool sharpening expert Al Price. Seven teeth were set an extra 1/64 in. to the left, seven to the right, and 12 were unaltered.) Mark teeth before setting, and use trial cuts to determine how much set gives the look you like.

You can rip wood to size or resurface precut stock. Rate of feed also affects texture—the faster you feed wood into the blade, the rougher the texture. On hefty stock, rip at a moderate, safe speed first; then move fence 1/32 in. closer to blade so only tips of extra-set teeth contact surface. Then push board through again, with a faster feed.



FIX JIG in vise, hold blade and strike teeth with ball-peen hammer as shown.

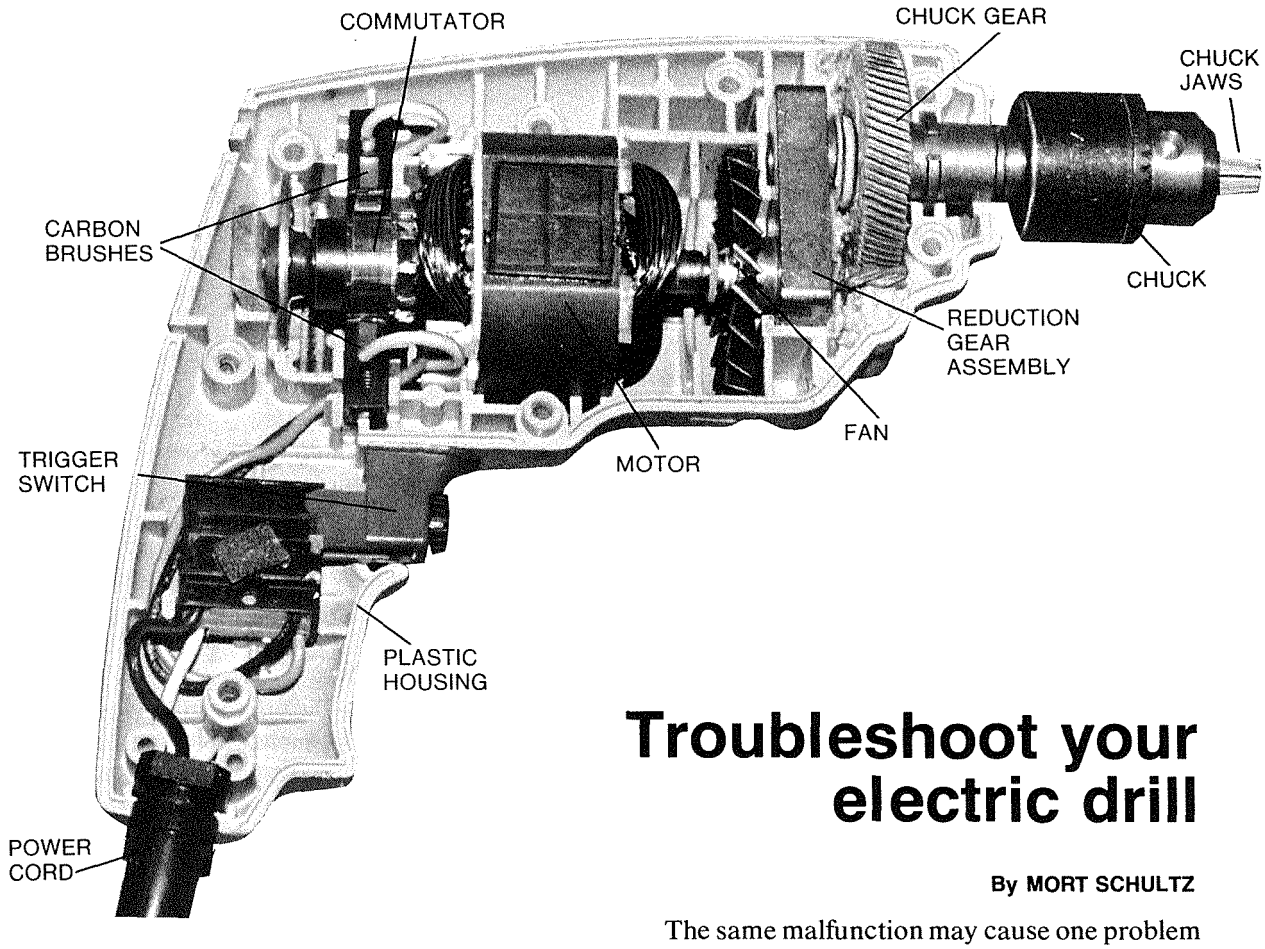




MATERIALS LIST—Saw-blade Setting Jig

Key	Pcs.	Size and description
A	1	¾ x 2 x 2¾" hardwood
B	1	¾ x 2 x 6" hardwood
C	1	1½ x 3½ x 10" hardwood
D	2	¾ x 2½ x 4" hardwood
E	1	¾ x 1½ x 10" hardwood

Misc.: bolt, screws, washers and dowel as shown in art.



Troubleshoot your electric drill

By MORT SCHULTZ

THERE'S A WRONG WAY and right way to treat an electric drill with a malfunction. The wrong way is to assume that new drills aren't expensive (high quality ones are) and throw away the old one. The right way is to fix the drill yourself. In most instances, you can.

Drills—¼, ⅜ or ½-inch—are simple machines. From the standpoint of repair, there are two basic kinds: clamshell and metal case. Most drills sold today are clamshell and double-insulated. To get inside such a drill, unplug from power and remove the housing screws and one half of the case. The entire mechanism will be exposed.

The other type drill has a metal case composed essentially of a front gear housing, bearing plate and rear housing. To get inside, remove the front gear housing, main drive gear and bearing, and bearing plate.

When an electric drill malfunctions, it usually reacts in one of four ways: (1) it goes on and off when the switch is held in the *On* position; (2) it won't run at all; (3) there is a noticeable power loss; (4) it makes noise.

The same malfunction may cause one problem in one drill and a different problem in another. However, the troubleshooting procedure, which follows, will allow you to pinpoint the cause and make repairs:

1. With the power cord plugged in, hold the switch in the *On* position and flex the power cord back and forth where it enters the housing. If the drill cuts on and off as the cord is bent, the cord is damaged.

To repair this defect in a clamshell-type drill, unplug the cord and separate the housing. Disconnect the cord from the switch, cut off two or three inches of the cord at the switch end, strip back insulation to expose wires and reattach the cord.

To repair this failure in a metalcase drill, remove the screws holding the two halves of the handle together, open the handle, disconnect the cord from the switch, then proceed as described above.

The only difficulty you may encounter is disconnecting and reconnecting the power cord and switch. The cord is attached to the switch by screws or by a spring. If by screws, loosen the screws to remove and reattach the cord.

If leads are attached to the switch by a spring, use a small finishing nail or an awl-type tool with a thin end to separate the wire from the switch. Insert the tool into the hole in the switch, push the spring aside and *gently* withdraw the wire from the switch. Don't pull on the wires. Reverse the procedure to reattach the lead.

Important: Wires must be reattached to their correct positions in the switch, so note these positions (make a sketch, if necessary) before making this repair. Most switches are marked in some way to facilitate identification.

2. The power cord can also be damaged at the plug end because of carelessness. To check the cord at this point, tie the switch in the *On* position, lay the drill on the floor, plug in the power cord, and flex the cord back and forth at the plug end. If operation is erratic, disconnect the cord, cut off several inches at the plug end, strip back wires, and install a new plug.

According to Gary Cohen, service center manager for Skil Corp. in Hillside, N.J., about 75 percent of all erratic operation is caused by a power-cord break. Almost 25 percent is caused by a bad switch, which can also prevent the drill from running at all.

3. Test a switch by detaching the two field wires from the switch. They are the wires that *aren't* the power cord wires.

Connect a test power cord to the two field wires. A test cord is good to have on hand and should have two alligator clips soldered to its wires for connection to field wires.

Caution: Before plugging in the test power cord, you must reassemble the drill to avoid possible serious electric shock. Screw the two clamshells together or reassemble the handle.

Plug in the test power cord. If the tool now performs satisfactorily, the switch is bad and should be replaced with a new one.

A brush spring or brush that fails to make contact with the commutator is another reason for erratic on-off operation.

4. With a clamshell-type drill, open the housing, depress the brush springs to disconnect the wires, remove the brush retainers (one on each side of the commutator) and take apart the brush assembly which consists of the brush, spring and retainer.

Caution: The power cord must be disconnected during Step 4.

To remove the brush and brush spring from a drill with metal housing, look for two slotted retainers on the housing. Unscrew them to release brushes and springs.

Separate the brush and spring, and depress and release the brush spring between your fingers. It should move freely.

Check the edges of the brush. If the brush has been making poor contact, one edge will be burned away more than the other.

If one brush or brush spring is damaged, replace all brushes and springs. Clean off the commutator with a clean rag and polish it lightly with very fine sandpaper. Do not use emery cloth on the commutator, and do not apply oil or grease.

Clean the slots in the commutator by passing a dull knife carefully through them. One pass per slot should be enough.

check worn brushes

Worn brushes will cause a drill to lose power. You can check on this without taking the brushes out of the drill by operating the drill and looking inside the tool through the cooling vents on both sides of the housing. You should see a fine line or arcing. If you see splashing on one or both ends, it means the brushes and springs should be replaced.

To prevent severe motor damage, worn brushes should be replaced at once.

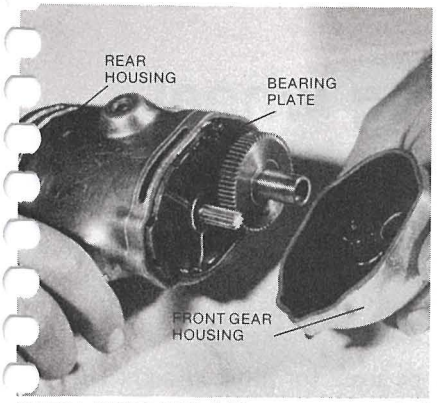
5. If your drill hangs up—that is, it revolves to a point and stops—chances are that an armature segment is burned severely. You can check on this by turning the chuck by hand. If the drill releases, rotates and hangs up again, the motor is burned.

It may not pay for you to have a motor repaired or replaced if your drill isn't a high-priced tool. However, if it is an expensive item, get an estimate from a manufacturer's repair facility before making the decision.

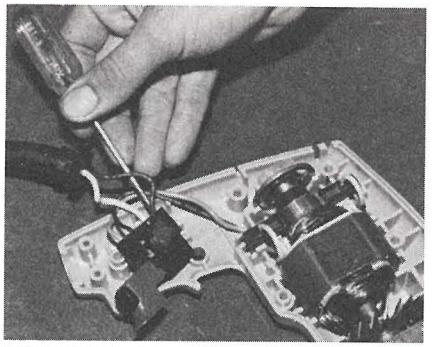
6. The last problem in drill malfunction is gear noise. This can be caused by lack of lubrication or by a damaged gear.

With a clamshell-type drill, remove and lubricate the gear with grease specified by the manufacturer for your drill. If the noise persists, replace the gear and bearing.

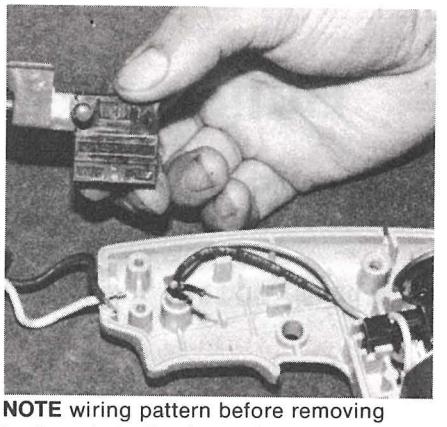
With a metal-case drill, remove the front cover and apply grease. The noise should disappear. If not, check gear teeth to see if one is stripped. If one is, replace the gear and bearing.



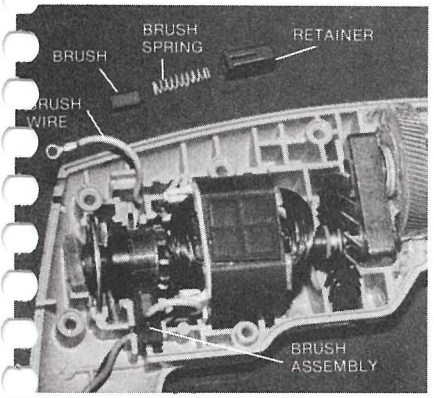
METAL-ENCASED drills are composed of the three main housings shown here.



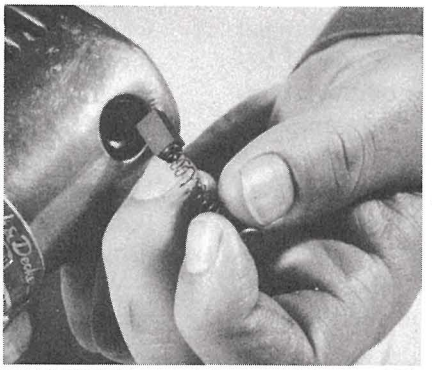
SWITCHES with spring-connected wires are disconnected with a thin-pointed tool. Wires may be attached to some switches with screws.



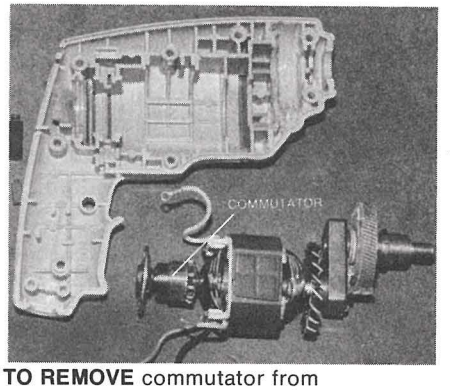
NOTE wiring pattern before removing faulty switch. Rewire replacement.



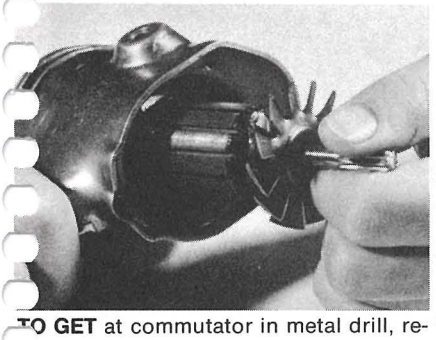
BRUSH assembly is often the key when drill is running, but is losing power.



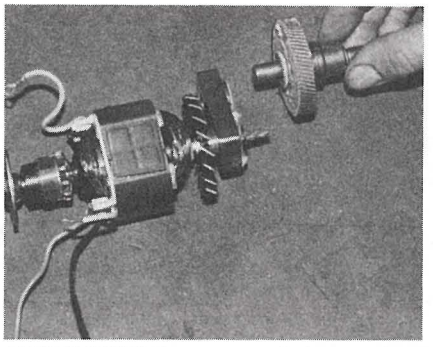
TO REMOVE a brush from metal-case drill, unscrew slotted retainer. Release it slowly to avoid losing spring.



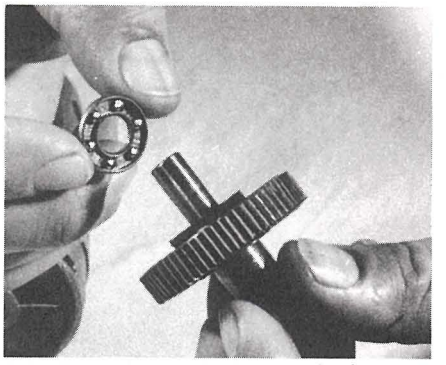
TO REMOVE commutator from clamshell-type housing for cleaning, lift it from casing along with rest of assembly.



TO GET at commutator in metal drill, remove front housing and brushes. Then remove main drive gear, bearing and bearing plate. Finally, pull out the armature.



DISASSEMBLE components by gently pulling them apart; slide together to reassemble.



WHEN you replace main gear, also be sure to replace main gear bearing.

TROUBLESHOOTING CHART

PROBLEM	CAUSES	PROCEDURE
Drill cuts on and off (runs intermittently)	Damaged power cord	Repair or replace cord
	Switch failure	Replace switch
	Poor brush/commutator contact	Replace all brushes, springs; dress commutator
	Burned armature segment	Replace motor or drill
Drill won't run at all	No power at wall outlet	Check and/or repair outlet
	Switch failure	Replace switch
	Burned-out motor	Replace motor or drill
Drill exhibits loss of power	Worn brushes	Replace brushes, springs; dress commutator
Drill is unusually noisy	Gear needs lubrication	Lubricate using grease made for drills
	Gear is stripped	Replace gear and bearing

Build an easy-to-use spinning wheel

By JOSEPH R. PROVEY

This contemporary quill-type 'Penguin Wheel' is simple to build from these plans—and could start you off on one of the most relaxing of hobbies

I PLAY FOOTBALL and baseball, have worked as a builder and don't take guff from anybody. I also like to relax by spinning wool into yarn.

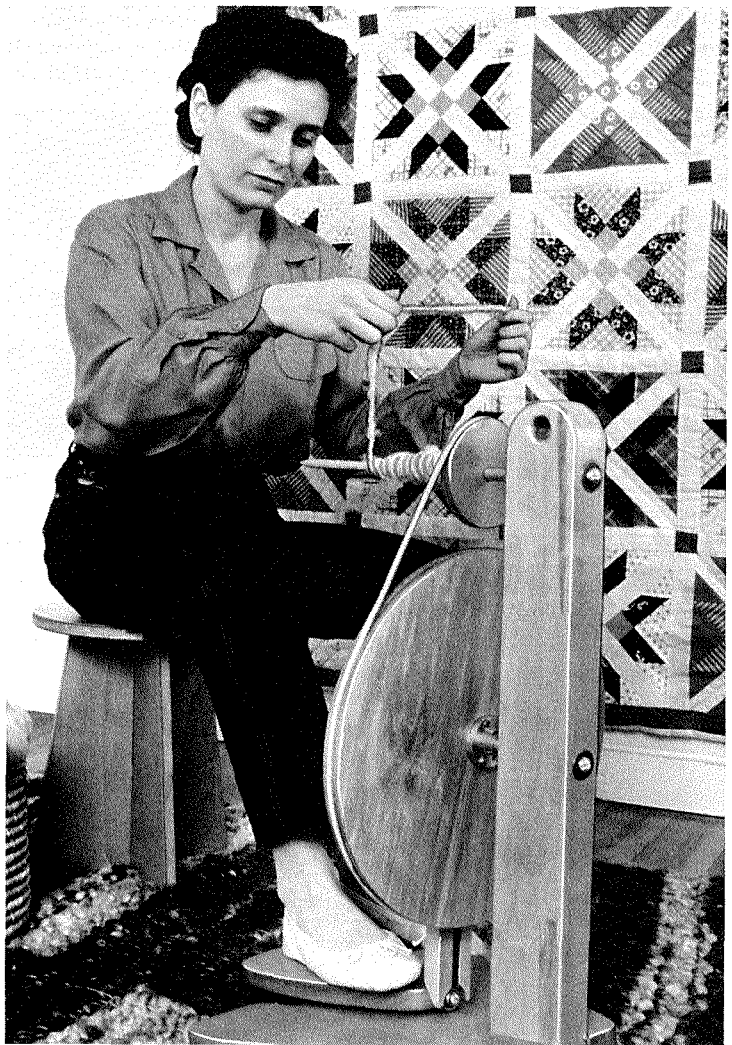
Surprisingly enough, it's an easy hobby to get started in. The Penguin Wheel (so named because it resembles the familiar, web-footed bird) is a clever quill-type design that's fairly simple to learn on. Compared to the price of most ready-made wheels ($200 and up), the Penguin is inexpensive to build. Be advised that many lumberyards will only sell the maple-veneer, lumber-core plywood by the full 4×8-ft. sheet.

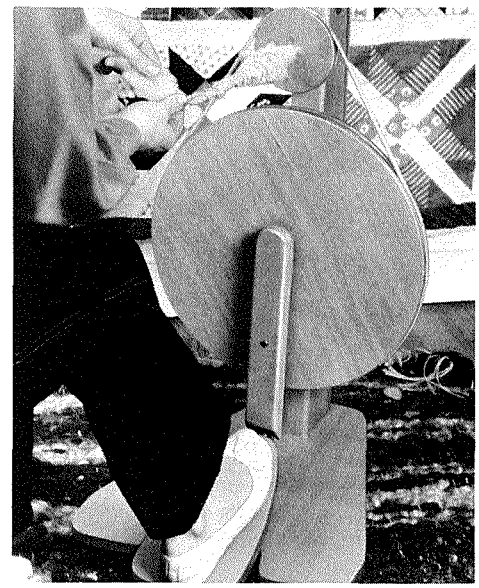
Cut all the pieces as shown in the plans. A bench saw can be used for most straight cuts, dadoes and grooves. A sabre saw will do for cutting curves and slots.

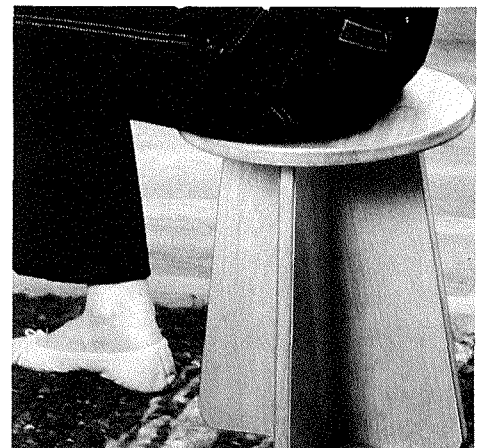
There are several special cuts and borings which you should pay attention to. When cutting the upright (F), for instance, be sure the sides are squared so that the holes for the bearings can be bored accurately.

To bore the axle shaft holes, first chuck a long ⅛-in.-dia. bit into a drill press. Mark hole locations. Then bore through the width. This will provide aligned pilot holes for the larger bits.

When cutting the notch in the base (C), note that the front edge of the notch should be cut at



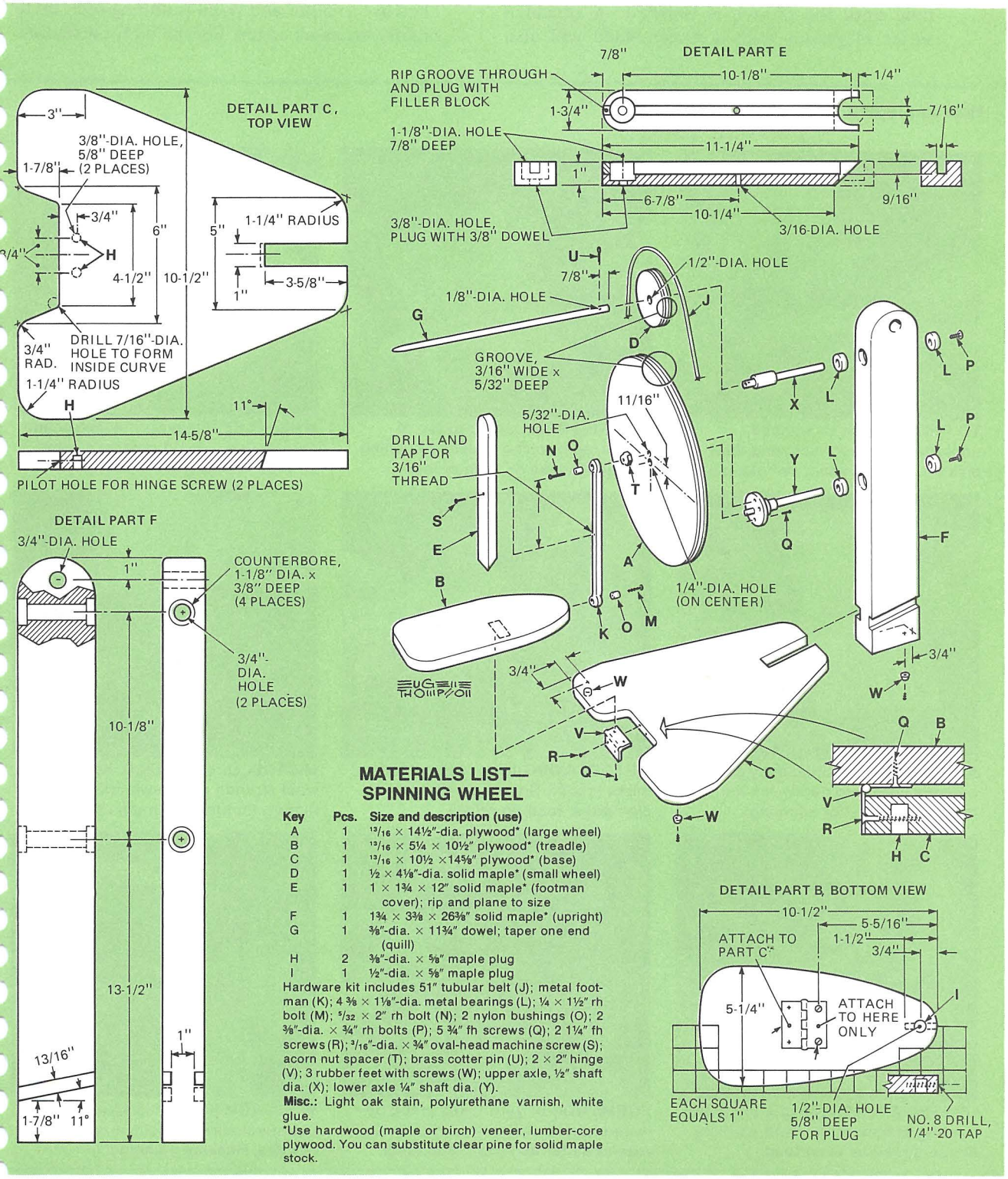




an angle to conform to the upright.

To cut out the wheels, a sabre saw with a circle-cutting guide works fine. Remember that when using a pivoting type of guide, the front edge of the blade must be directly in line with the pivot point.

Cutting the grooves on the wheel edges can also be tricky. Construct the jig shown in photo on page 129 and clamp to the bench-saw fence. Be sure the common nail used as pivot at wheel's center penetrates securely through the vertical board. The wheel should be snug against the



MATERIALS LIST— SPINNING WHEEL

Key	Pcs.	Size and description (use)
A	1	13/16 × 14½"-dia. plywood* (large wheel)
B	1	13/16 × 5¼ × 10½" plywood* (treadle)
C	1	13/16 × 10½ ×14⅝" plywood* (base)
D	1	½ × 4⅛"-dia. solid maple* (small wheel)
E	1	1 × 1¾ × 12" solid maple* (footman cover); rip and plane to size
F	1	1¾ × 3⅜ × 26⅜" solid maple* (upright)
G	1	⅜"-dia. × 11¾" dowel; taper one end (quill)
H	2	⅜"-dia. × ⅝" maple plug
I	1	½"-dia. × ⅝" maple plug

Hardware kit includes 51" tubular belt (J); metal footman (K); 4 ⅜ × 1⅛"-dia. metal bearings (L); ¼ × 1½" rh bolt (M); 5/32 × 2" rh bolt (N); 2 nylon bushings (O); 2 ⅜"-dia. × ¾" rh bolts (P); 5 ¾" fh screws (Q); 2 1¼" fh screws (R); 3/16"-dia. × ¾" oval-head machine screw (S); acorn nut spacer (T); brass cotter pin (U); 2 × 2" hinge (V); 3 rubber feet with screws (W); upper axle, ½" shaft dia. (X); lower axle ¼" shaft dia. (Y).

Misc.: Light oak stain, polyurethane varnish, white glue.

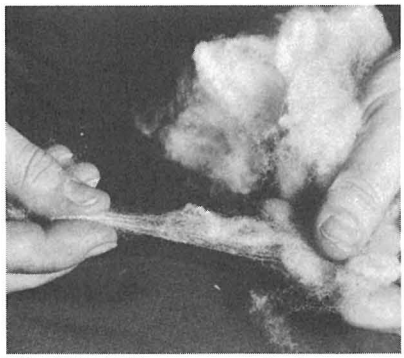
*Use hardwood (maple or birch) veneer, lumber-core plywood. You can substitute clear pine for solid maple stock.

board, but not tight. To make the cut, lower the dado and slide the fence into place, so the blade will cut a 3/16-in.-wide groove in the center of the wheel edge. Turn on saw and slowly elevate the dado until it contacts the workpiece. Rotate the work in the same direction as the blade spins. Make several passes, elevating the blade each time until the groove is finished. A repeated series of passes with a single blade will also work.

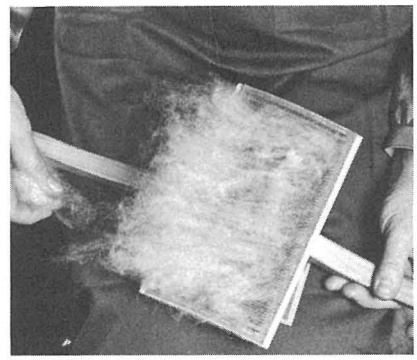
The footman cover is straightforward, but note that when you are boring the 1⅛-in. holes, the drill point will penetrate the workpiece face. Bore ⅜-in.-dia. holes at these penetrations and plug them to conceal the holes.

After cutting out all parts, sand them smooth. Then use a router and ¼-in. rounding-over bit to slightly break all edges. Set the bit for a shallow

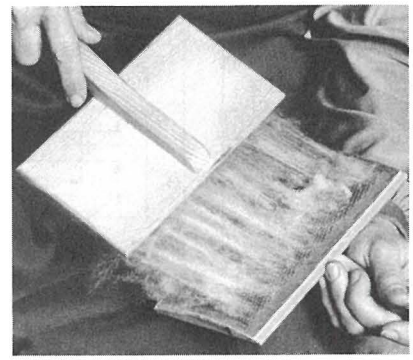
How to prepare and spin raw wool



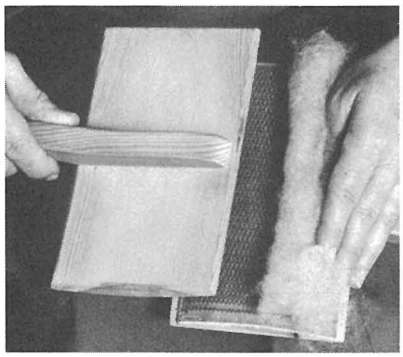
TO PREPARE raw or washed, uncarded fleece for spinning, first pick the strands apart; remove burrs.



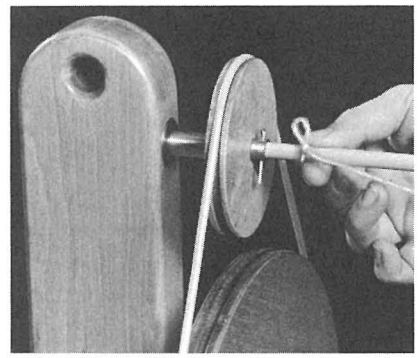
MOVING FROM bottom to top of carder, apply picked fleece by pulling it across hooks on face of tool.



WHEN FLEECE covers the face of one carder, use second carder to comb strands. Comb several times.

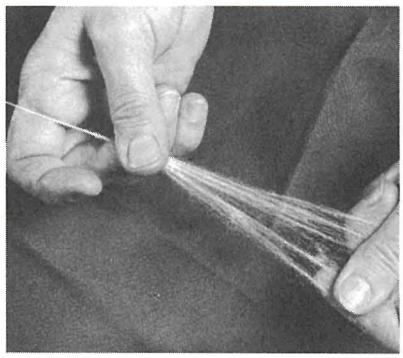


AFTER FLEECE is sufficiently carded, use one carder to gently roll it into rolag (roll ready for spinning).

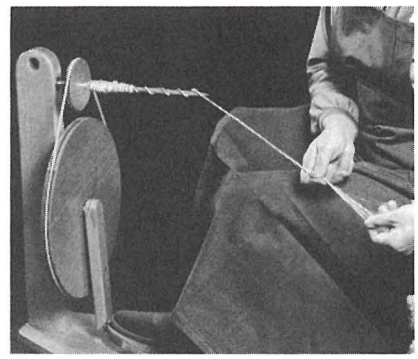


TIE FOOT-LONG piece of scrap yarn to make leader. Begin spinning wheel clockwise, feed on rolag.

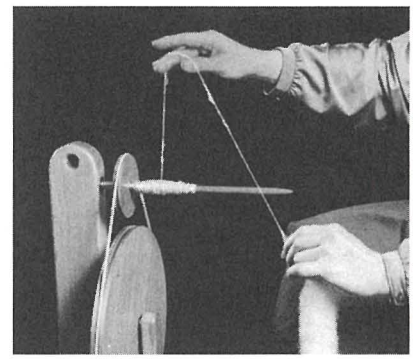
MICROSCOPIC NATURAL hooks on wool strands are drawn into twisting leader. Interlocking halts unraveling.



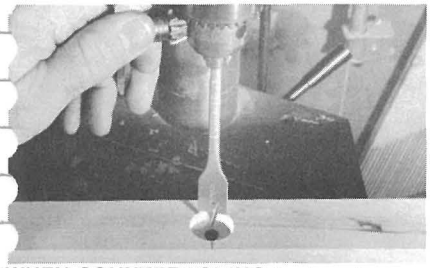
USE THUMB and forefinger to control twisting action; other hand spreads fleece, provides even feed.



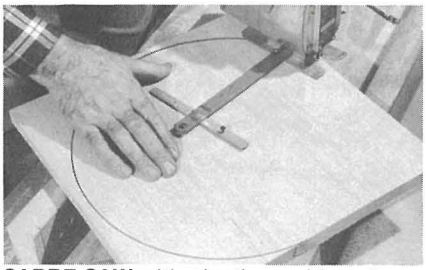
FORMATION of yarn takes place between hands, which should eventually extend as far as possible to side.



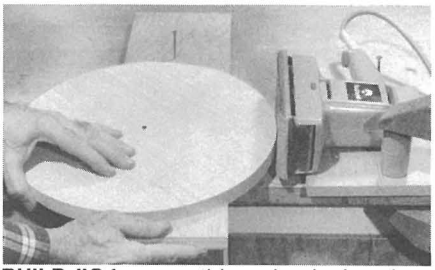
WHEN ARM'S length is spun, back up counterclockwise, collect yarn on spindle. Resume spinning.



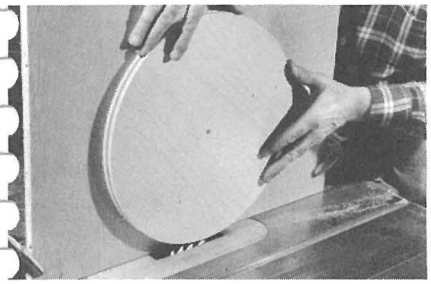
WHEN COUNTERBORING for bearings, bore larger hole first. Otherwise, entering larger bit would be impossible.



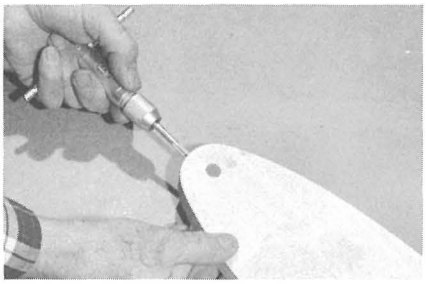
SABRE SAW with pivoting guide cuts perfect circle. Position blade against edge of board. Drive in pivot nail.



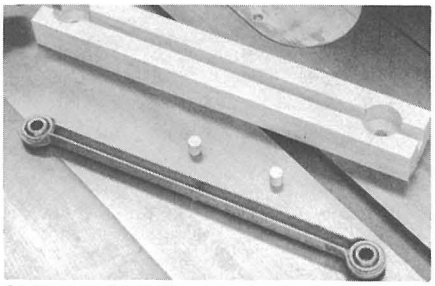
BUILD JIG for smoothing wheel edges by clamping sander to board, nailing assembly to bench. Wheel rotates on nail.



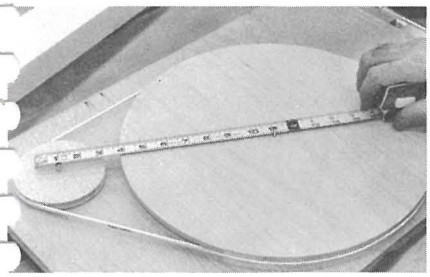
TO CUT edge groove, lower dado head and clamp jig to fence. Turn on saw, elevate cutter slowly, rotate wheel into cutter.



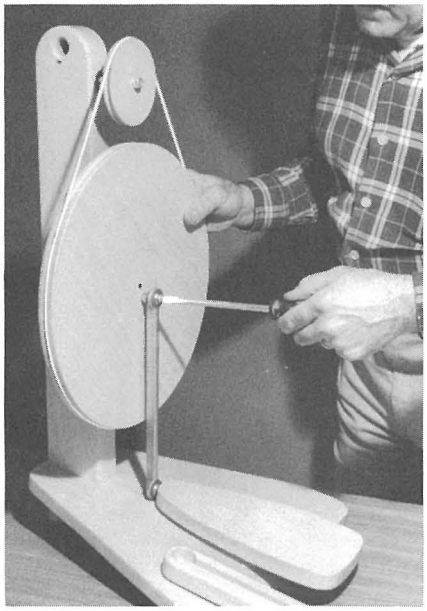
TO KEEP THREADS for footman bolt from stripping, drill and tap hole in dowel after gluing it into treadle.



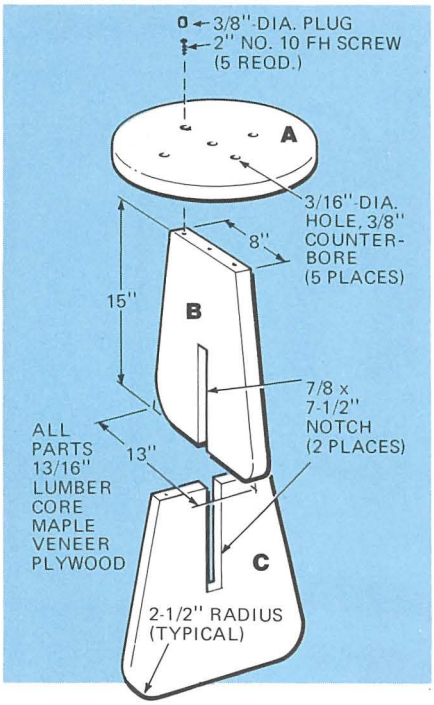
GLUE A WOOD filler block into the top end of footman cover to plug the void you made while cutting the groove.



CENTER-TO-CENTER spacing for bearings can be double-checked by test assembling wheels and belt before drilling.



SCREW OFFCENTER bolt (N) into pretapped hole in axle hub. Note: Attach drive belt *before* installing the footman.



MATERIALS LIST—STOOL

Key	Pcs.	Size and description (use)
A	1	13/16 × 12"-dia. plywood* (seat)
B	1	13/16 × 13 × 15" plywood* (support); cut slot at bottom
C	1	13/16 × 13 × 15" plywood* (support); cut slot at top

*hardwood-veneer, lumber-core plywood for best results.

Misc.: 5 3/8"-dia. plugs; 5 2" No. 10 fh screws; light oak stain; satin polyurethane varnish (or to suit); white glue.

cut on all plywood pieces to prevent rough feathering at edges. A deeper cut can be taken on the footman cover and the upright. Note: Round the edges on upright (F) *before* boring the bearing holes to prevent pilot on bit from slipping into voids.

For best results, apply a stain and/or a clear finish before final assembly.

simple stool construction

After cutting the parts using a sabre saw, ease all plywood edges, as done on the spinning wheel parts. Sand and finish pieces to match the wheel, except for the top of the seat. Assemble with screws and plug holes.

Check your local library for books on spinning, and before long you will be enjoying this relaxing hobby.

GENEROUSLY proportioned work surface (above) includes slop sink with drain for bathing, feeding and watering plants—plus a removable dry sink that's great for localizing the mess during repotting jobs. A shelf with circular cutouts provides accessible storage for pots and keeps them from getting broken. A handy tool rack (left) keeps trowels, pruners and other potting tools within an arm's reach.

DOWEL SUPPORTS let you preen your hanging plants as they will be when on display.

DEEP SLIDING drawers hold planting mediums. The middle drawer locks to store dangerous chemicals.

A RACK on the end of the bench holds the hose and keeps it from tangling underfoot.

A potting bench: beautiful and efficient

If your green thumb is looking for a spot to call its own, build our potting bench. It includes a slop sink, a dry sink, and lots of room for your supplies

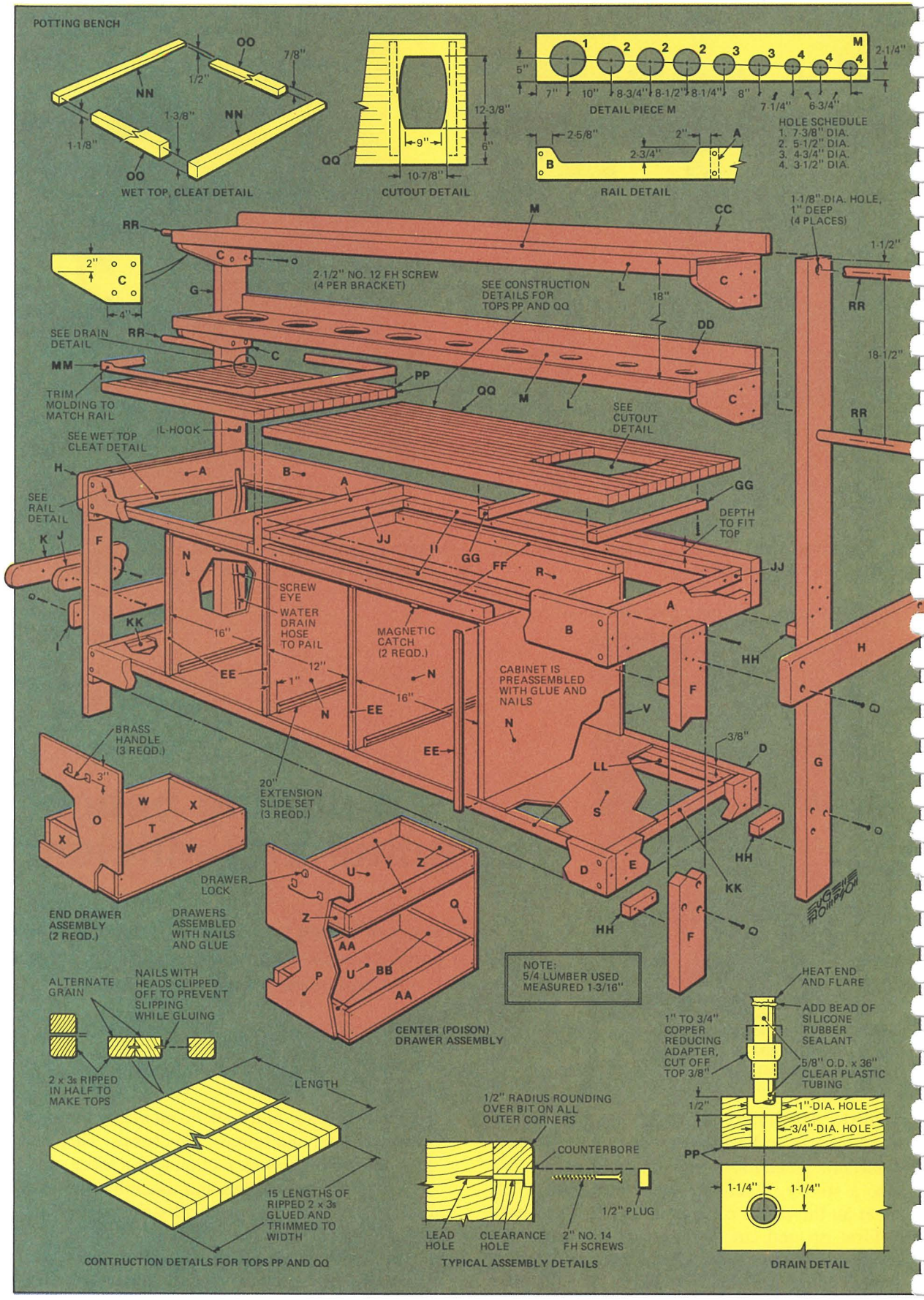
By ROSARIO CAPOTOSTO

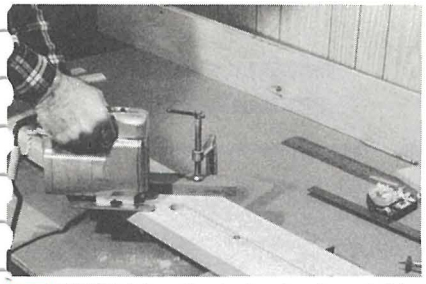
■ THIS POTTING BENCH not only looks good enough to be the centerpiece in a porch, solarium, greenhouse or back-yard patio—it's also a sturdy, functional work center that will meet all the needs of even an expert gardener.

First rip and cut 5/4-in. stock to length for upper and lower rails. Assemble rectangular frames with bar clamps to facilitate drilling pilot holes for screws. Mark all the members for easy assembly later and remove the clamps. Then cut the contour for the sink section with a sabre saw.

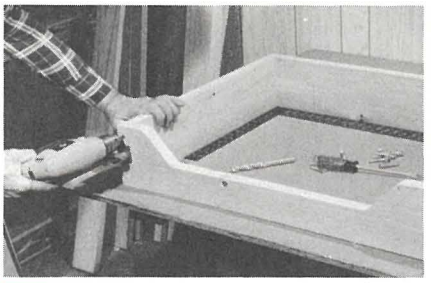
Mix plastic resin glue and assemble the two rectangles. Tack-nail diagonal strips across the edges until the glue has dried.

The four legs are fitted with cleats which add extra glue surface, but, equally important, they

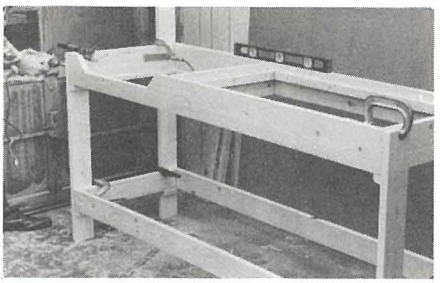

POTTING BENCH
WET TOP, CLEAT DETAIL
CUTOUT DETAIL
DETAIL PIECE M
HOLE SCHEDULE
1. 7-3/8" DIA.
2. 5-1/2" DIA.
3. 4-3/4" DIA.
4. 3-1/2" DIA.
RAIL DETAIL
1-1/8"-DIA. HOLE, 1" DEEP (4 PLACES)
2-1/2" NO. 12 FH SCREW (4 PER BRACKET)
SEE CONSTRUCTION DETAILS FOR TOPS PP AND QQ
SEE DRAIN DETAIL
TRIM MOLDING TO MATCH RAIL
SEE WET TOP CLEAT DETAIL
L-HOOK
SEE CUTOUT DETAIL
SEE RAIL DETAIL
DEPTH TO FIT TOP
SCREW EYE
WATER DRAIN HOSE TO PAIL
MAGNETIC CATCH (2 REQD.)
CABINET IS PREASSEMBLED WITH GLUE AND NAILS
BRASS HANDLE (3 REQD.)
20" EXTENSION SLIDE SET (3 REQD.)
DRAWER LOCK
END DRAWER ASSEMBLY (2 REQD.)
DRAWERS ASSEMBLED WITH NAILS AND GLUE
CENTER (POISON) DRAWER ASSEMBLY
NOTE: 5/4 LUMBER USED MEASURED 1-3/16"
ALTERNATE GRAIN
NAILS WITH HEADS CLIPPED OFF TO PREVENT SLIPPING WHILE GLUING
2 x 3s RIPPED IN HALF TO MAKE TOPS
LENGTH
15 LENGTHS OF RIPPED 2 x 3s GLUED AND TRIMMED TO WIDTH
CONTRUCTION DETAILS FOR TOPS PP AND QQ
1/2" RADIUS ROUNDING OVER BIT ON ALL OUTER CORNERS
COUNTERBORE
1/2" PLUG
LEAD HOLE
CLEARANCE HOLE
2" NO. 14 FH SCREWS
TYPICAL ASSEMBLY DETAILS
HEAT END AND FLARE
ADD BEAD OF SILICONE RUBBER SEALANT
1" TO 3/4" COPPER REDUCING ADAPTER, CUT OFF TOP 3/8"
5/8" O.D. x 36" CLEAR PLASTIC TUBING
1"-DIA. HOLE
3/4"-DIA. HOLE
DRAIN DETAIL



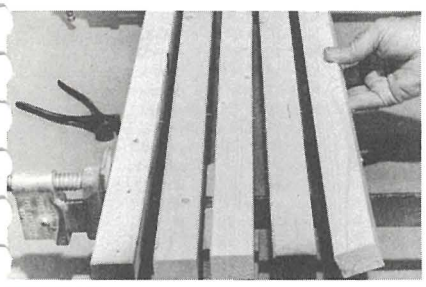
1 **BORE** 1-in.-dia. holes in slop sink's front to form corners. On straight cuts, use a clamped-on guide.



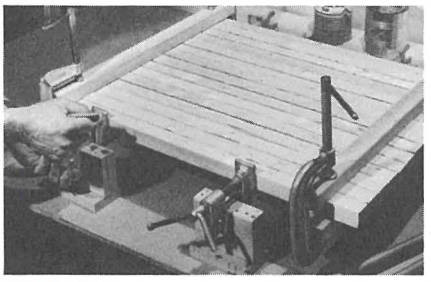
2 **CLAMP** frame before boring pilot holes. Drill three holes, one each for pilot, shank and plug.



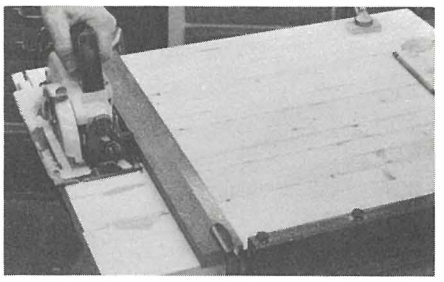
3 **FRAME** should be level when boring holes. Since floors are seldom level, use shims if needed.



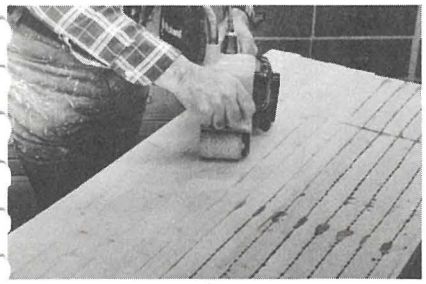
4 **NAIL** "pins" are used to align the boards for edge gluing. Number pieces for each final assembly.



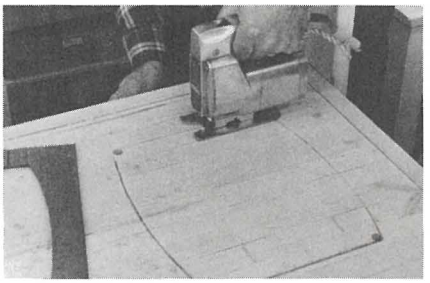
5 **USE** wax paper and boards clamped on surfaces to keep assembly from buckling under pressure.



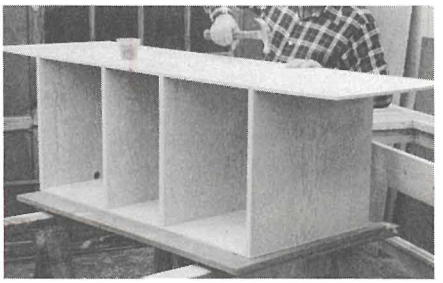
6 **TOPS** are too bulky to crosscut on a table saw. Instead, clamp a guide and use a portable saw.



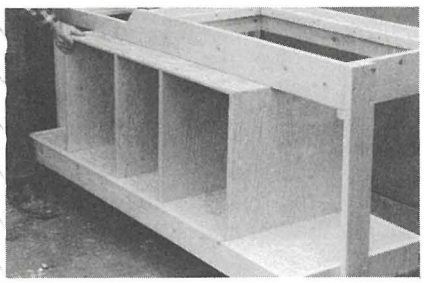
7 **BELT** sander is only way to quickly true-up surface. First, shave off glue with a sharp chisel.



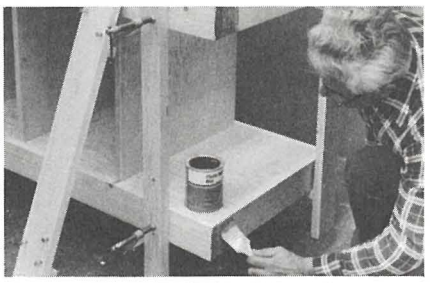
8 **USE** a sabre saw to make opening in top. Note the test cutout in the scrap paneling at left.



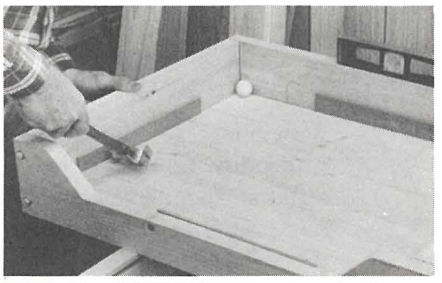
9 **NAILS** and glue are used to assemble cabinet case. Exposed plywood edges are finished with wood strips.



10 **CABINET** case and lower rails are installed as a single unit during the final assembly.



11 **A TEMPORARY** 2×3 leg, clamped to rails, permits removal of true leg for applying glue.

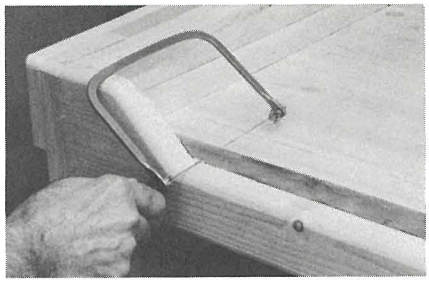


12 **TO POSITION** cleats, prop bottom into position and tack guide strips. Ball shows where water will drain.

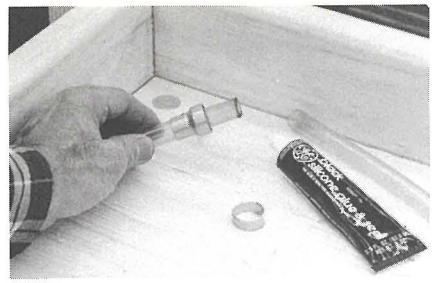
help the assembly. Nail and glue in the cleats, then clamp the legs in place and bore the screw pilot holes. *Note:* Do not glue the legs in place until the lower cabinet has been completed and installed.

To make the two tabletops, cut 2×3s to the lengths required—plus a few extra inches—then rip them in half to get two $1^{3}/_{16}\times1\frac{1}{2}$-in. pieces from each 2×3.

To glue the tops together, follow this procedure: Clip the head from a 1-in. nail and use it as a bit to bore a pair of holes in one side of each strip, about ½ in. deep. Clip the heads from a bunch of same-sized nails and push them into the holes

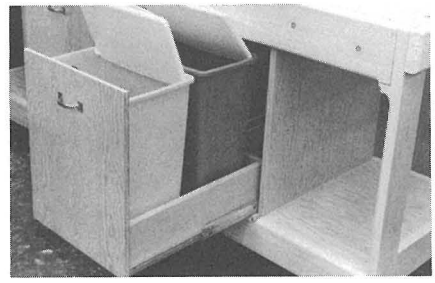


13 **COPING** saw cuts off excess molding after it's installed—after you mark it in position and clamp to bench.

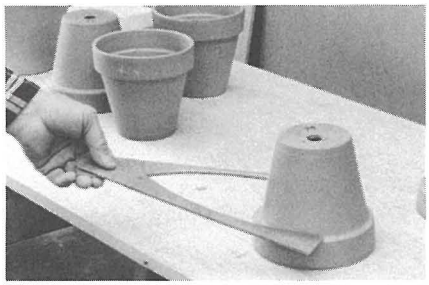


14 **PLUMBING** consists of a sawed-off reducing adapter and clear plastic tube. Flare the tube end to fit.

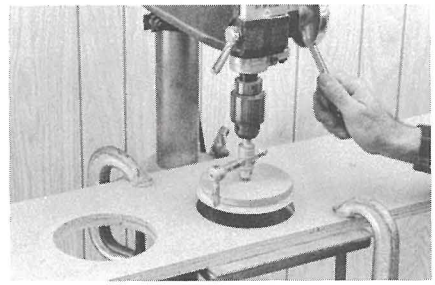
15 **KEYED** lock is fitted into a ⅞-in.-dia. hole. The sliding drawer hardware is designed for heavy loads.



16 **THE OUTSIDE** drawers are designed to accommodate two plastic bins and permit easy access.



17 **TO SIZE** holes for pots with diameters other than those shown, make a simple caliper using wood scraps.



18 **USE** a fly cutter in a drill press only; clamp work firmly on both sides. Or, make cutouts with a sabre saw.

MATERIALS LIST—
POTTING BENCH

Key	Pcs.	Size and description
A	3	13/16 × 5½ × 22″ pine
B	2	13/16 × 5½ × 75″ pine
C	4	13/16 × 5½ × 10¾″ pine
D	2	13/16 × 4 × 75″ pine
E	2	13/16 × 4 × 22″ pine
F	2	13/16 × 4 × 36″ pine
G	2	13/16 × 4 × 72″ pine
H	2	13/16 × 4 × 24⅜″ pine
I	1	13/16 × 3¼ × 24⅜″ pine
J	1	13/16 × 3¼ × 9½″ pine
K	1	13/16 × 3¼ × 17½″ pine
L	2	13/16 × 1½ × 75″ pine
M	2	¾ × 10¾ × 75″ plywood
N	4	¾ × 19⅝ × 21¾″ plywood
O	2	½ × 15⅞ × 19½″ plywood
P	1	½ × 11⅞ × 19½″ plywood
Q	1	½ × 10⅞ × 16″ plywood
R	1	⅜ × 21¾ × 47″ plywood
S	1	⅜ × 22 × 72⅝″ plywood
T	1	⅜ × 14 15/16 × 21″ plywood
U	2	⅜ × 10⅞ × 20½″ plywood
V	1	¼ × 20 × 47″ plywood
W	2	¾ × 5¼ × 21″ pine
X	2	¾ × 5¼ × 13 7/16″ pine
Y	2	¾ × 2½ × 20½″ pine
Z	2	¾ × 2½ × 9⅜″ pine
AA	2	¾ × 3 × 20½″ pine
BB	2	¾ × 3 × 9⅜″ pine
CC	1	¾ × 2½ × 77¼″ pine
DD	1	¾ × 2½ × 75″ pine
EE	4	⅜ × ¾ × 19⅝″ pine
FF	2	1¼ × 1½ × 30″ cleat
GG	2	1¼ × 1½ × 19″ cleat
HH	8	1⅛ × 1⅛ × 4″ cleat
II	2	1¼ × 1½ × 40½″ cleat (rip from 2×3)
JJ	2	1¼ × 1½ × 22″ cleat (rip from 2×3)
KK	2	1 × 1 × 22″ cleat
LL	2	1 × 1 × 70⅝″ cleat
MM	4	1⅜″ × 8′ doorstop molding (cut to fit)
NN	2	1½ × 1½ × 22″ fir
OO	2	1½ × 1½ × 25″ fir
PP	15	21 15/16 × 27 5/16″ (2×3s ripped in half)
QQ	15	22 × 43½″ (2×3s ripped in half)
RR	4	1⅛″-dia. × 12″ closet pole

Misc.: 20″ Full-extension slides, Grant No. 328; 1″ to ¾″ copper reducing adapter; ⅝″ O.D. × 36″ plastic tubing; silicone rubber sealant; drawer lock; 3 drawer pulls; plastic dishpan.

with pliers so that about ⅜ in. of each point protrudes. Lay the strips, sawed edge down, on a flat surface. Then press them together so the nail points mark the mating piece. Number the pieces in sequence so they don't get mixed up during gluing, then take them apart.

Use several pairs of boards clamped to the front and back of the top to keep the assembly true. Glue and clamp for about 12 hours.

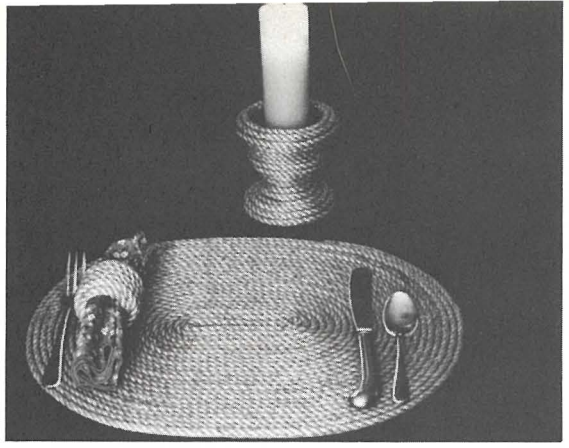
Use a belt sander to remove all glue lumps and saw ripples. Then trim off the excess stock at ends and sides.

Straight cleats are used to support the large tabletop while the small top requires tapered cleats to achieve the necessary pitch so water will drain. Tack-nail the cleats in place and test the two tops for fit before gluing-in the cleats. Do not glue-in the tops until the cabinet has been installed. Also, before gluing-in the sink surface, bore and counterbore the hole for the drain—a copper pipe reducing adapter and a piece of clear plastic tubing.

The adapter is too long as is, so ⅜ in. must be cut off the top. To flare the tubing end, use a heat gun or hair dryer.

The cabinet is made as a completed unit and slipped into place on 1×1 cleats which are glued to the insides of the lower rails. The back panel should not be attached until after the drawers have been installed.

Make the drawers and then attach the slides before adding the plywood drawer fronts. Use a ½-in.-radius rounding-over router bit to round the edges.



Use coiled rope for table setting

■ ROPE CRAFT is an enjoyable pastime that you can use to add an attractive nautical look to your table setting. Here are directions for making place mats, napkin rings and candleholders.

To begin work, diagonally cut off the rope tip following the twist of one of the three strands. Using a glue gun, saturate the end with glue and twist the rope end into a smooth taper.

Use plenty of hot glue to attach the rope to a surface. Work a 2- or 3-in. length at a time, so you can place the rope in hot glue 10 to 15 seconds after the glue has been applied.

SUPPLIES

Materials: ¼-in.-dia. Manila rope, as smooth as available, with fewest visible fibers; wax paper; fabric-backed vinyl upholstery material; plastic dime-store or old candleholders; 1½-in.-o.d. PVC plastic pipe; masking tape; 80-grit sandpaper.

Tools: Bostik's Thermogrip Electric Glue Gun or other glue gun with hot-melt glue sticks; utility knife; tape measure; scissors; hacksaw.

place mats

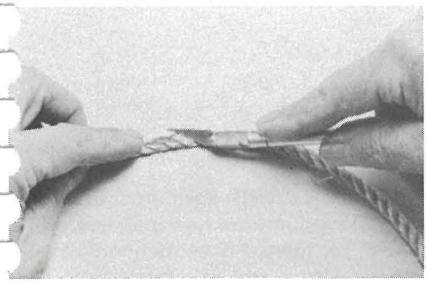
To make a 13×18-in. oval place mat, you'll need about 50 ft. of rope. Tightly tape a 15×20-in. piece of fabric-backed vinyl upholstery to a work surface, face down. Square-cut one end of the rope, treat it with glue, and pinch the end fibers together. Lay a ⅛×4-in. bead of glue in the center of the vinyl, parallel to the long axis. Position the first 4 in. of rope and hold it in place. Follow the natural curve of the rope and glue an adjacent segment, making a very tight bend.

candleholders

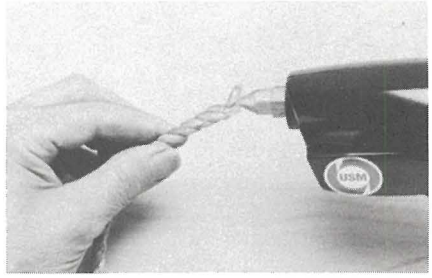
With the candleholder sitting on its own base, start work at the bottom by laying a 2-in. bead of glue on the tapered end of the rope. Press the rope into place at the base. Continue gluing and winding.

napkin rings

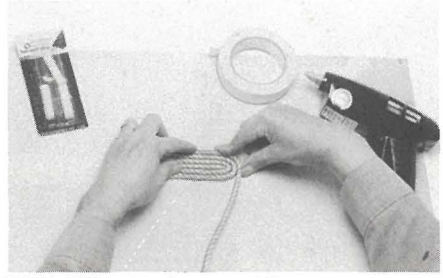
Begin work by hacksawing 1½-in.-long sections of 1½-in. o.d. PVC pipe. Sandpaper the ends and outside surface. Completely cover with rope.



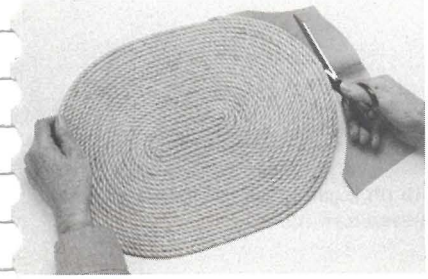
CUT THE ROPE diagonally in the direction of the twist to taper the end.



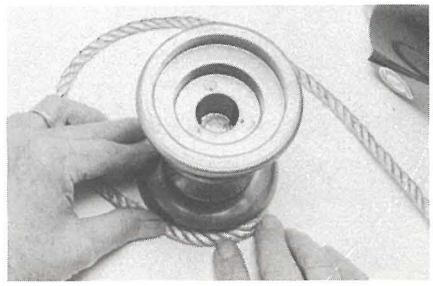
SATURATE strand ends with glue and taper with fingers covered by wax paper.



FOLLOW natural curve of the rope as you glue it to vinyl upholstery backing.



WHEN the place mat is done, trim off excess vinyl, so rope conceals the edge.



BEGIN WINDING at the candleholder base. Apply glue to rope and press.

NAPKIN RINGS are short lengths of PVC pipe covered with coils of glued-on rope.

GREAT FOR PATIO, lawn, pool or court-side, foldup furniture has sparkling eye appeal, yet rugged construction that will withstand the rigors of outdoor use.

CAPTAIN'S CHAIR and folding lounge complete our set. Plans for the latter are on facing page; for all other plans, please turn the page.

Build classic canvas lawn furniture

It's handsome, sturdy and simple to construct. Since these pieces fold compactly, you can use them on your deck or patio, at the beach or even inside your home

By DAVID WARREN

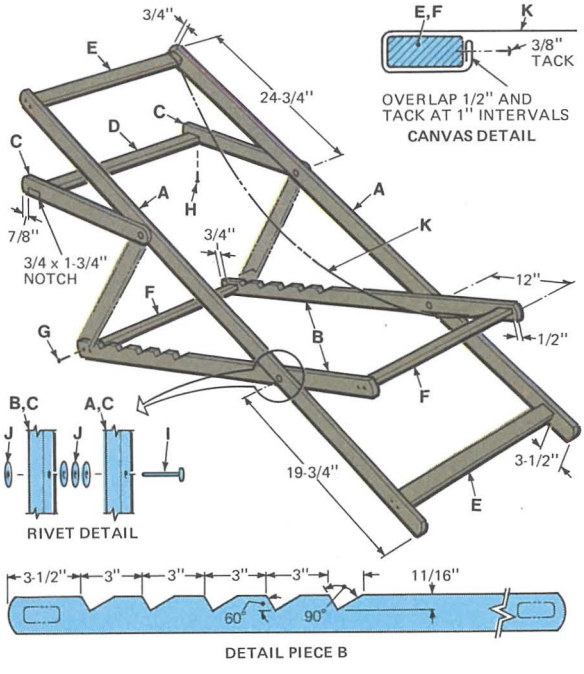
■ HERE'S OUR WAY to build four classic wood-and-canvas folding chairs.

Start construction of the lounge by cutting out each pair of framing members plus the stop bar. Round the ends of the risers, seat bars and adjusting bars to a 2-in. radius.

Lay out and cut the adjustment notches in the seat bars. Cut the notch in the adjusting bar to receive the stop bar. Round the edges of each piece with a 3/8-in. radius router bit, and sand the surfaces.

Next, bore the two 3/16-in. dia. rivet holes in each riser bar and the rivet hole in the seat bar. Bore the 11/64-in. body holes for No. 8 fh wood screws in the seat bar and riser bars and countersink them. Bore the corresponding 7/64-in. pilot holes in the ends of the four support bars. Similarly, bore and countersink the body holes in the stop bar and pilot holes in the adjusting bar.

FOLDING LOUNGE CHAIR



Assemble supports to risers, and supports to seat bar. Then rivet riser bars to the seat bars and to the adjusting bars.

Sand and finish the wood and fasten canvas in place. Space carpet tacks 1 in. apart. Use two decorative upholstery tacks at the edges of the canvas on each of the bars.

Begin construction of the director's chair by ripping the 2-in.-wide armrest tapers from 2 to 1 7/16-in. Start taper 1¾ in. from the end. Lay out and saw the tapered sides to 1 7/16 in.

Then turn tenon ends. Set workpiece up in lathe and turn the ¾-in.-dia. tenon. Remove from lathe and round over the two upper edges of the arms with a 3/8-in.-radius router bit. Then saw the 2-in.-dia. front-end curves with a bandsaw. Repeat for second arm; sand both parts smooth.

Next, rip 1¾-in.-square by 18-in.-long blanks for the turned back supports. Mark centers and turn pieces. Remove from lathe and plane the 1-in. wide flat area on the front of the piece.

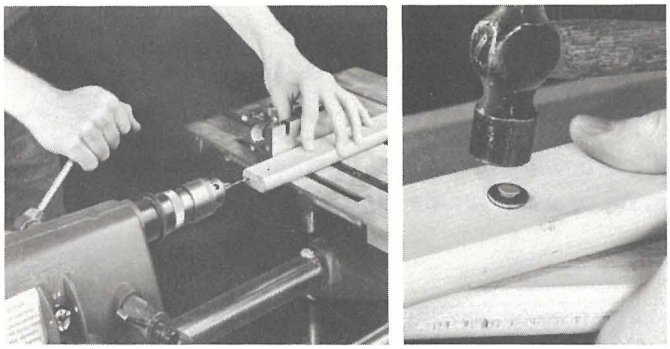
Cut the ¾-in. dowels about 8 in. long for the two front supports. Then turn the 5½-in.-long pieces with 5/8-in. tenons at each end.

Next, cut the upper and lower arm support pieces together so they will match exactly.

Center punch for the ¾-in. and 5/8-in.-dia. mortise holes in the upper arm support pieces. Bore the 5/8-in. hole ½ in. deep. Assemble the two uprights to the support and to the armrest. Mark the location of the round mortise in the rear upright so that the armrest will be parallel to the lower arm support. First glue both uprights to lower arm support. Then glue armrest to the rear upright and front upright.

Rip four cross legs on table saw. Round four edges of each with 3/8-in.-radius router bit. Lay out and cut 45° angles at both ends of the cross legs. Sand smooth. Bore 3/16-in. rivet holes in the centers.

Lay out and bore 11/64-in. body holes at top ends of legs and matching 7/64-in. pilot holes in bottom of lower seat support. Countersink holes in legs.



BORE ⅛-in. pilot holes in the ends of the lounge-chair stretcher, supports, other parts. Pilot holes can be bored with Shopsmith in horizontal position (left). Broad-headed rivets (right) won't unscrew.

Bore the ⅝-in. blind mortise holes in the cross legs for the leg support stretchers. Make the right and left leg support stretchers by turning tenons at the ends of ¾-in. pieces of doweling.

Assemble seat supports to cross legs with fh wood screws. Glue ¾-in. round support stretchers to the cross legs. Then rivet cross legs together with three spacer washers. Next, bore pilot holes for the folding bracket hardware and attach it.

Join the upper and lower assemblies with a pair of tight pin hinges on each side. Sand and finish.

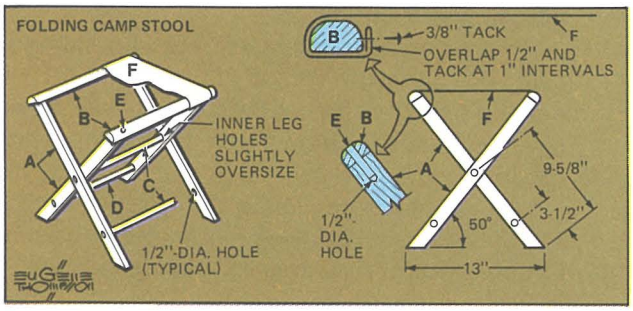
To install the canvas seat, remove the hinge from the lower seat support and then fasten the canvas to the outside edge of the lower seat support with decorative upholstery tacks spaced 1 in. apart. Double-stitch the back piece with loops at either end and slip it over the back uprights to complete the director's chair.

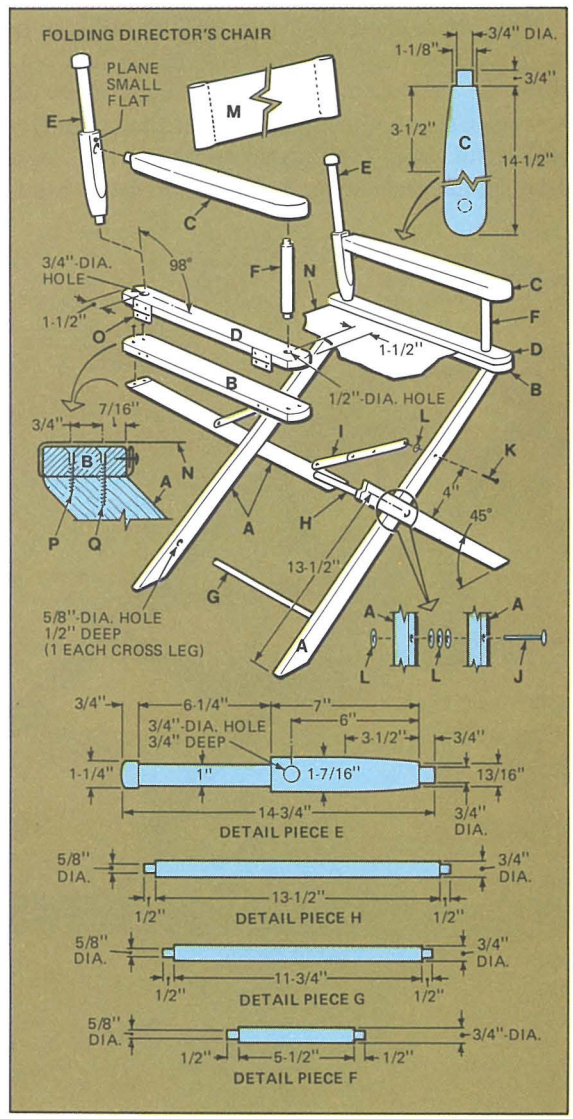
Rivets—Soft malleable iron rivets with large heads were used in all pieces except the camp-stool.

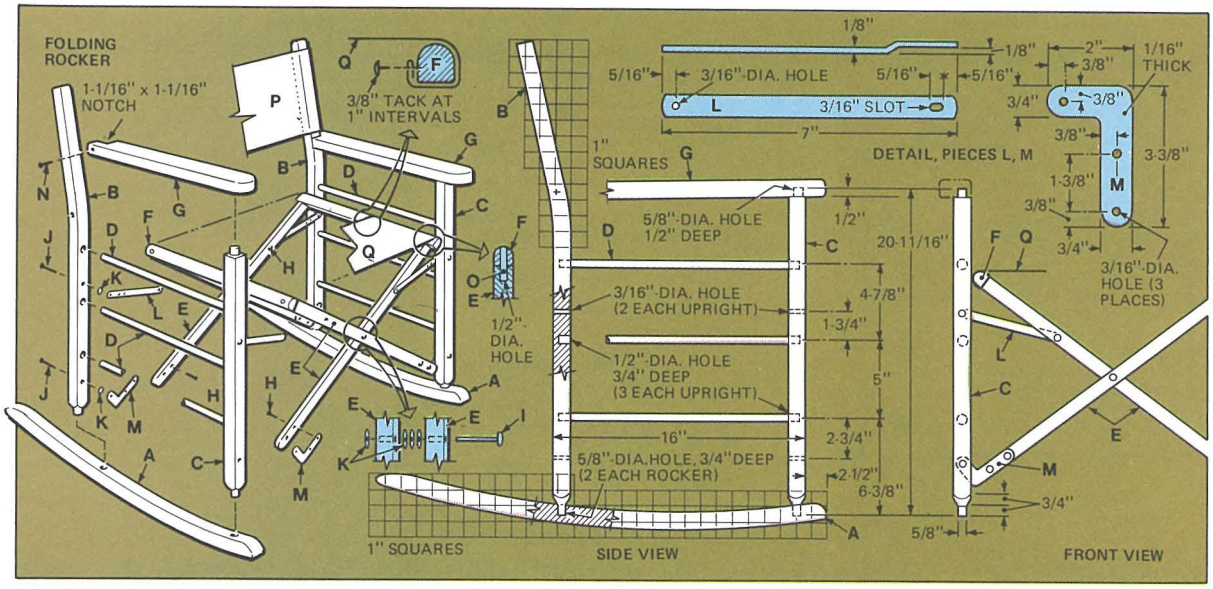
Size the diameters of the holes so that the rivets will fit tightly. Use three retainer rings as spacer washers between two pivoting wooden members. Size the rivet so there is sufficient metal projecting to make a broad head. To form the head, put a retainer ring over the projection and a metal plate underneath the opposite rivet head. Then slowly peen over the rivet end.

Finish—The white maple chairs were sanded thoroughly and finished with two coats of satin polyurethane varnish. First seal the wood with a thin coat of orange shellac.

Canvas—After the wood pieces have been finished, install the canvas. Cut all pieces of the 18-oz. canvas chair duck oversize. Each canvas piece should be a few inches longer than needed. Then cut to finish length during final assembly—*after you have fastened one end in place and measured for the other end.* Also allow for a 1-in. hem on both sides. Sew hems and end loops with double stitching. Space the rows ¼-in. apart.







For the camp stool rip the four legs and two top pieces to 1¼ in. wide from ¾-in.-thick stock, and then cut pieces to length. Saw the 45° angle for the four feet.

Next, bore the ½-in.-dia. center pivot and lower stretcher holes through the four legs. The center holes in the inner legs should be slightly oversize for a free fit of the dowel pivot rod. Cut one lower stretcher dowel 11½ in. long and one 13 in. long. Also cut the center pivot dowel 13 in. long. Next, bore the ½-in. holes through the top seat support and into the ends of the legs (see detail in the drawing). Cut the four ½-in. dowel pins 1¾ in. long that join the seat support to the legs.

To round the four edges of the six pieces of stock, use a router rounding over bit with ⅜-in. radius.

Make final assembly of the top supports to the legs with dowel pins and glue. Next, glue the lower stretchers to each pair of legs. Then glue the center stretcher/pivot in place. Keep the glue on the outside legs only. Keep inside legs free to pivot.

Shellac and varnish the assembly. Lay out, cut, and hem the canvas. Then wrap canvas around left seat support, make a ½-in. foldover, and tack in place with carpet tacks. Space tacks 1 in. apart. Then bring canvas over and around right seat support. Cut off excess canvas so legs will have desired splay. Wrap canvas around top and fasten with tacks as you did the left side.

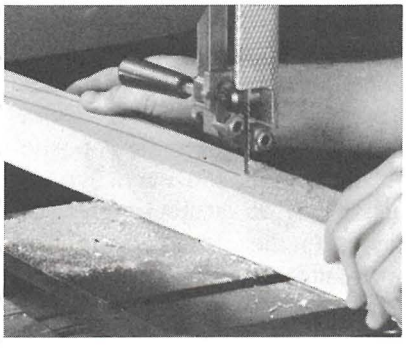
Start construction of the rocker by cutting out two armrests. Bandsaw the front curve of the armrests.

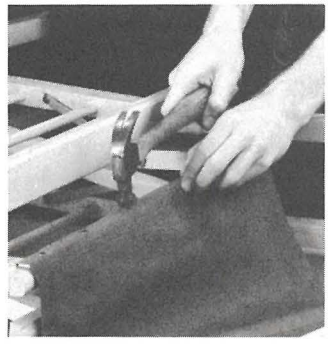
Cut two front uprights. Mark lathe centers on the two front uprights, and turn ¾-in.-dia. tenons at either end. Turn the top tenons ½ in. long and the bottom tenons ¾ in. long.

Lay out two runners per drawing, and cut out on bandsaw. Sand both edges using disc and drum sanders.

Next, lay out rear uprights as shown in the drawing. Cut off waste with a bandsaw. Mark

ROCKER RUNNER (left) is cut out on bandsaw. Center, carpet tacks are driven through canvas and wood strip and into the seat support. Sew ½-in.-wide hem with double row of stitching on both edges of canvas parts. We used a No. 18 needle.





MATERIALS LIST—FOLDING ROCKER

Key	Pcs.	Size and description (use)
A	2	1⅛ x ⅛ x 28½" (rockers)
B	2	1-1/16 x 1-1/16 x 30" (rear uprights)
C	2	1-1/16 x 1-1/16 x 19¾" (front uprights)
D	6	15½" x ½"-dia. dowels (upright supports)
E	4	⅞ x ⅞ x 21¼" (crosspieces)
F	2	⅞ x ⅞ x 16½" (seat supports)
G	2	1-1/16 x 2 x 17½" (armrests)
H	12	1¼" x 3/16"-dia. rivets
I	2	2½" x 3/16"-dia. rivets
J	8	1½" x 3/16"-dia. rivets
K	40	3/16" i.d. washers slightly over 1/16" thick
L	4	⅛" thick x ½ x 7" steel supports
M	4	1/16 x 2 x 3⅜" steel angles
N	2	2" No. 8 fh screws
O	4	1½" x ½"-dia. dowel plugs
P	1	9 x 20½" finished-size canvas
Q	1	*6 x 18" finished-size canvas; allow for sewing edges, wraparound and tacking

Misc.: Heavy-duty thread (synthetic), plastic resin glue, satin polyurethane varnish

MATERIALS LIST—DIRECTOR'S CHAIR

Key	Pcs.	Size and description (use)
A	4	¾ x 1½ x 27" (cross legs)
B	2	¾ x 2 x 16" (seat supports)
C	2	1-1/16 x 2 x 18" for turning (armrests)
D	2	¾ x 2 x 16" (arm supports)
E	2	1¾ x 1¾ x 17" for turning (rear arm supports)
F	2	9" x ¾"-dia. dowel for turning (front uprights)
G	1	18" x ¾"-dia. dowel for turning (left leg support)
H	1	18" x ¾"-dia. dowel for turning (right leg support)
I	1	⅝ x 8" folding bracket
J	2	1⅞" x 3/16"-dia. rivets
K	2	1" x 3/16"-dia. rivets
L	12	3/16" i.d. washers slightly over 1/16" thick
M	1	6 x 21¾" finished size canvas
N	1	14 x 22" finished size canvas (allow material to finish edges and assembly)
O	4	Dull brass tight-pin hinge
P	4	1¼" No. 10 fh screws
Q	4	1½" No. 10 fh screws

Misc.: Heavy-duty thread (synthetic), 4 nylon glides, plastic resin glue, satin polyurethane varnish

MATERIALS LIST—CAMPSTOOL

Key	Pcs.	Size and description (use)
A	4	¾ x 1¼ x 19¾" (cross legs)
B	2	¾ x 1¼ x 15" (seat supports)
C	2	13 x ½"-dia. dowels (leg supports)
D	1	11½ x ½"-dia. dowel (leg support)
E	4	1¾" x ½"-dia. dowels (inserts)
F	1	13 x 14" finished size canvas (allow more material to finish edges and assembly)

Misc.: Heavy-duty thread (synthetic), ny glides, plastic resin glue, satin po urethane varnish

MATERIALS LIST—LOUNGE CHAIR

Key	pcs.	Size and description (use)
A	2	¾ x 1¾ x 66" (risers)
B	2	¾ x 1¾ x 44" (seat bars)
C	2	¾ x 1¾ x 21" (adjusting bars)
D	1	¾ x 1¾ x 23½" (stop bar)
E	2	¾ x 1¾ x 20¼" (supports)
F	2	¾ x 1¾ x 18½" (supports)
G	16	2" No. 8 fh screws
H	4	1¼" No. 8 fh screws
I	4	1⅞" x 3/16"-dia. rivets
J	16	3/16"-i.d. washers slightly over 1/16" thick
K	1	18 x 72" (approx.) canvas; allow material for finishing edges and assembly

Misc.: Heavy-duty thread (synthetic), 4 nylon glides, plastic resin glue, satin po urethane varnish

lathe centers for turning. Set up securely in lathe and turn lower tenons ¾ in. dia. by ¾ in. long. For safety, rotate work piece in the lathe by hand a couple of revolutions, then run lathe at its slowest speed. Sand edges smooth. Mark centers and turn round tenons at both ends of the two front uprights.

Locate and bore the dowel and rivet holes in the front and rear leg uprights. Bore these blind dowel holes with a flat-profile wood bit ¾ in. deep. Bore the 3/16-in. rivet holes through the stock.

Use back uprights as patterns for the respective notches in the backs of the armrests. Cut notch, then bore ¾-in. blind mortises ½ in. deep in the underside of the armrests for the front upright tenons. Bore an 11/64-in. body hole through the back armrest and bore a 7/64-in. pilot hole into each rear upright for 1½-in.-long No. 8 fh wood screws. Countersink the holes in the armrests.

Next, cut the three ½-in. dowel stretchers that join the upright legs. Make a trial assembly of legs, stretchers, and armrests for each side to check that everything will fit.

To lay out precise locations and angles of mortises in the rocker runner, lay a runner on its side on top of bench. Place rocker side in proper location so the ¾-in.-dia. tenons touch the runner. Then mark center point and angle to bore the ¾-in.-dia. round mortise in the top of the runner.

To guide the boring of the mortises in the runner at the proper angle, clamp runner to 2×4 and, steadying the rocker on the drill-press table, bore two ¾-in. mortises ⅞ in. deep in each runner.

Assemble each rocker side with glue. Clamp and allow to dry overnight.

Cut four crosspieces to size, and round one end of each on a bandsaw. On the other ends, lay out and bore a ½-in. hole ¾ in. deep. Cut out seat supports and curve upper edge as per drawing. Bore ½-in. holes ½ in. deep to join supports to crosspieces.

Mark and bore all 3/16-in. rivet holes in crosspieces. Cut ½-in. dowel pins that join crosspieces and seat supports. Assemble crosspieces to seat supports with glue. Clamp until dry. Then rivet the crosspieces together with a metal spacer.

Steel hardware—Lay out the steel angles on 1/16-in.-thick stock. Cut out with a hacksaw and file edges smooth. Center-punch and drill three rivet holes. Lay out and cut four steel support pieces from ⅛-in.-thick stock. File the edges smooth. Center-punch and drill a 3/16-in. hole in one end and a 3/16-in. slotted hole at the opposite end. Form ⅛-in. offset bend using a metalworking vise and hammer. Rivet steel angles and steel support pieces to the crosspieces. Then rivet steel supports and steel angles to the uprights to complete assembly. Finally, sand and finish the chair and install the canvas.

Make gleaming tableware from pewter

By BRUCE R. GUYOT

■ ALTHOUGH PEWTERSMITHING is an age-old craft, the pewter objects crafted today have a contemporary appeal, thanks to updated designs and materials. Modern pewter sheet comes from the mill with a highly-polished finish that will remain untarnished indefinitely with proper care.

Aside from the attraction of the finished objects, you'll find that working with pewter is a pleasure in itself. Pewter is soft enough to be shaped by pounding with plastic mallets. It has a relatively low melting point so that it is easy to solder. (This low melting point, however, rules pewter out for making ovenwear.) For the most part you can use the woodworking tools you already have to make pewter items. In fact, about 75 percent of the tools that I use professionally are woodworking tools.

cutting pewter

Pewter is a soft metal that's quite easy to cut in any number of ways, depending on the tools you have. The pewter should be supported on both sides of the cut as you work. *Note:* Be sure to wear safety goggles and, if you cut for long periods, also wear ear protection.

The most accurate way to make a straight cut is with either radial-arm or bench saw. Use a plywood- or veneer-cutting blade. A hand sheet saw also makes straight cuts. This is a special hacksaw without a thick spine that allows deep cuts into sheet stock.

SCORING, CUTTING, SHAPING, FILING, SOLDERING

USE EITHER a commercial scoring tool or a common nail to scribe the pewter. Be sure to apply only a light pressure to this soft metal.

A HAND SHEET saw will make fine straig cuts. Take care to support the metal on both sides of the cut with plywood underneath it.

TO MAKE a cylinder, clamp the form in a vise; then bend the pewter by hand and lightly tap the ends together.

IF THE CYLINDER fits loosely on a for... file seam edges by rubbing on a saw spir covered by 220-grit abrasive.

Making curved cuts requires other tools. A bandsaw makes clean outside curves. A scroll, sabre (with fine blade only), coping or jig saw make both outside and inside cuts.

shaping pewter

You can shape sheet pewter by pounding it into or bending it around a hardwood form. These forms can be turned on your lathe.

When you pound a pewter bowl or other concave shape into a wood form, start at its perimeter and work in gradually diminishing circles until you reach center. Then work from the center back to the perimeter. Repeat the process, feeling for bumps with your fingers to smooth the metal surface.

To make a pewter cylinder, or truncated cone shape, such as the tankard, bend the metal around a hardwood form. The form should be longer than the pewter piece, so it can be gripped in a vise. The pewter should close snugly around the wood form or leave a gap of no more than $^1/_{16}$ in. If the metal fits loosely on the form, sand the edges to fit. If the gap is larger than $^1/_{16}$ in., cut and try another piece. Seam edges must be even to solder.

soldering pewter seams

Iron binding wire wrapped around the pewter shape keeps the seam edges together when you solder. Cut one or more wire lengths and wrap them near the ends.

Into a clean glass dish, cut as many $^1/_{16}$-in. bits of 60-40 solder as you'll use in one working session. Hang the pewter piece on a rod, seam side down. Brush flux on the inside of the seam and deposit solder bits on the flux at ½-in. intervals and at each end, so they straddle the seam.

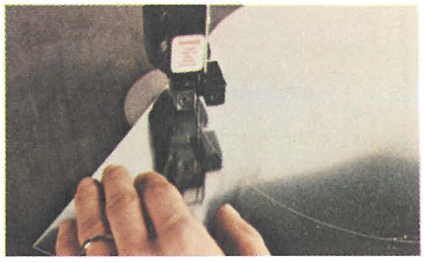
Set the torch to a low flame and apply heat under the seam outside the cylinder. The solder will melt soon after the flux begins to boil. *Keep the torch moving. Pewter melts at close to the same temperature as solder does.*

Finish the inside of the pewter (see instructions) before you solder the top and bottom pieces.

Cut both top and bottom pieces oversize. Brush-finish bottom with 400-grit abrasive. Rest the bottom disc on a flameproof surface. Protect all seams and soldered areas from heat by brushing on a creamy mixture of ochre and water. Flux the bottom of the cylinder, center it on the disc and position $^1/_{16}$-in.-long bits of 63-37 solder on the seam. This solder melts at a lower temperature than that used on the vertical seam.

finishing the metal

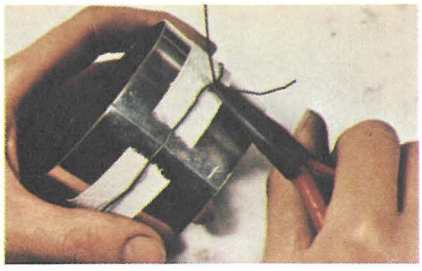
As you solder, keep light pressure on the cylinder top to assure a tight seam. If the piece is to hold liquid, fill it with water to check for leaks. If



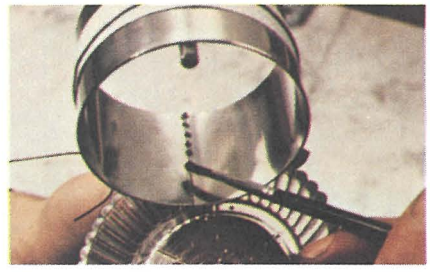
THE BEST WAY to cut the outside curves is with a bandsaw. If a bandsaw is not available, a sabre, scroll or coping saw can be used.

SANDWICH the pewter disc in a wood form. Clamp the assembly firmly to a bench. When the form and pewter are secure, pound to shape using a mallet.

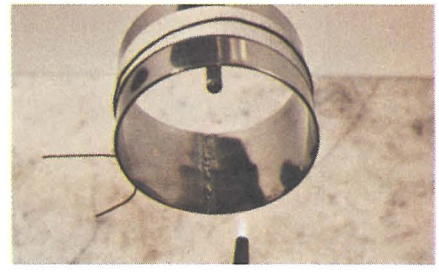
BEGIN pounding around the perimeter of the bowl, and continue to work in circles that become smaller in diameter each time until you reach the center.



TWISTED iron binding wire keeps edges together for soldering. Sheet asbestos shield under the wire is optional.

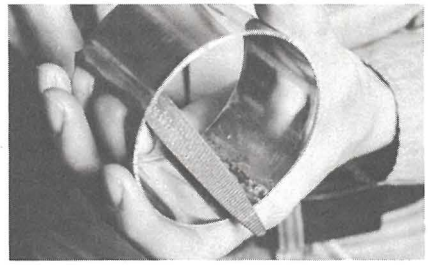


HANG THE CYLINDER by a rod secured in a vise. Brush flux on inside seam and deposit solder bits on the flux.

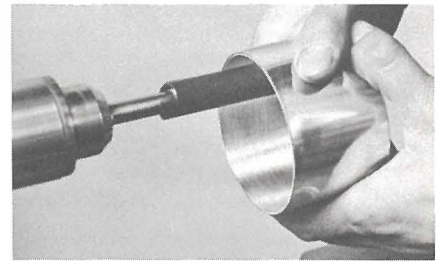


MELT SOLDER by applying torch heat under the seam. Keep the torch moving to heat both sides of the seam evenly.

SURFACE FINISHING, SOLDERING BOTTOM PIECES



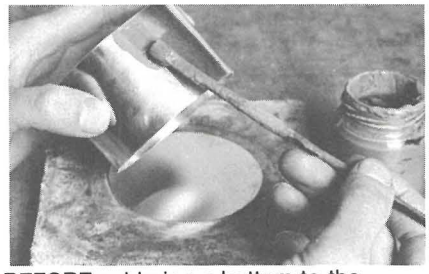
FILE diagonally across the seam to remove solder points. Then force the cylinder over the form to reshape it.



TO FINISH interiors, chuck a ¼-in.-dia. steel rod; tape 220-grit abrasive, rough side out. Repeat with 400-, 600-grit.

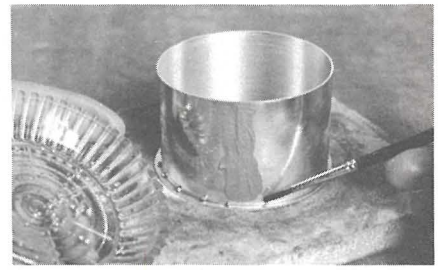
SAND THE BOTTOM and top edges of the cylinder by placing it on 220-grit paper and working in a circular motion.

HEAT THE bottom seam area. Keep light pressure on the cylinder with a block of wood to assure a tight seam.



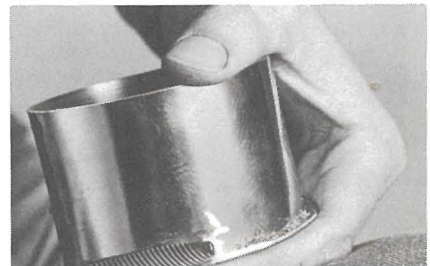
BEFORE soldering a bottom to the cylinder, cover seam (inside and outside) with ochre mixed with water until it's creamy.

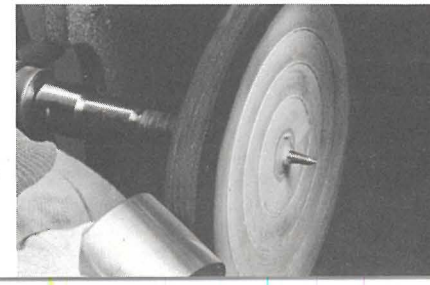
FILE OFF the bottom lip and excess solder; smooth vertical seam. Remove file marks with 220-, then 400-grit sandpaper.

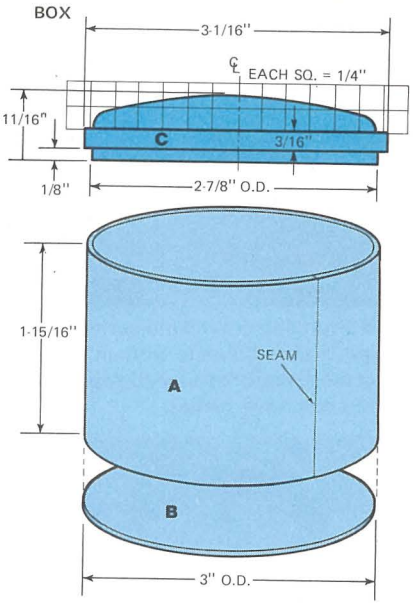


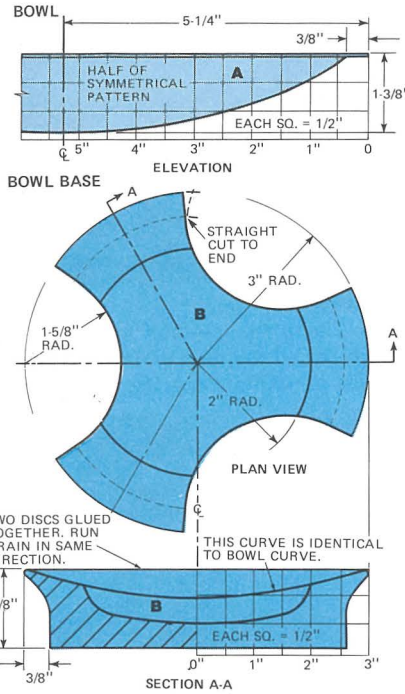
SET THE oversize bottom on flameproof surface, apply flux, position cylinder and place bits of 63-37 solder on lip.

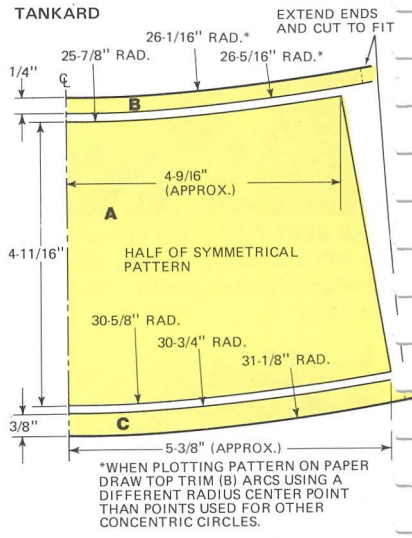
ROTATE the buff at 3500 rpm and apply tripoli cutting compound. Move the cylinder on the buff's lower quadrant.



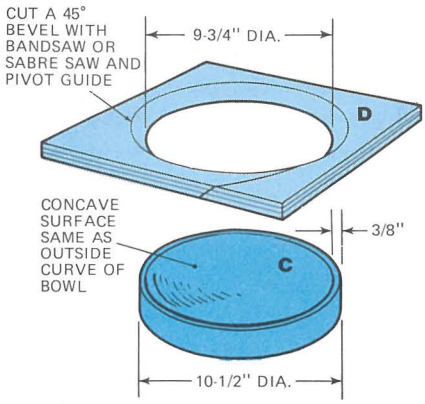


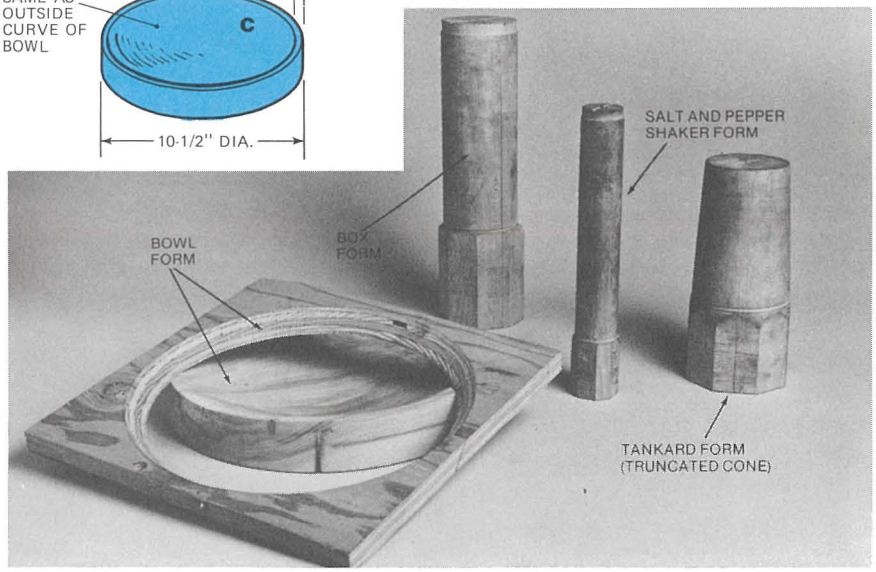


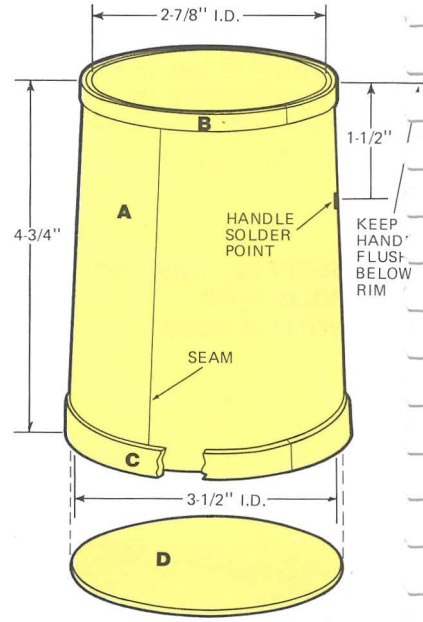




BOWL FORMS



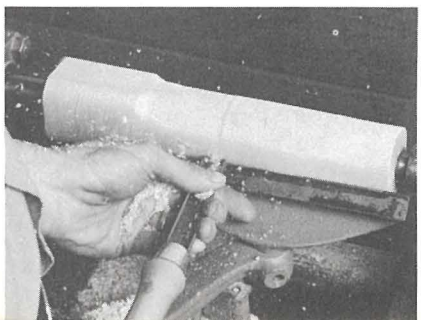




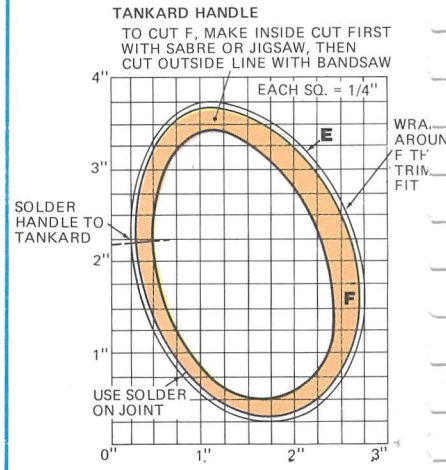
NOTE: MAPLE FORM FOR SHAPING HAS O.D. EQUAL TO TANKARD'S I.D.

TO SHAPE sheet pewter, bend or pound it to conform with hardwood forms like these.

TWO WOODTURNING techniques are shown below. On the left, spindle turning is used to make cylindrical forms for shaping pewter objects. On the right, faceplate turning is illustrated. This technique is used for dish forms.



TANKARD HANDLE



you must patch a leak, cover other soldered areas with ochre.

If the interior of the piece won't be visible, as in a salt shaker, for example, just remove the solder residue from the inside seam by filing diagonally across the seam with a half-round file. If the finished piece is open, finish it with 220-, 400- and 600-grit sandpaper. A steel rod chucked in a lathe or drill press with a length of sandpaper taped to it makes a good tool for fine-finishing the interior of the piece.

Reshape the piece by forcing it over the hardwood form. Sand the bottom and top edges of the cylinder, or other shape, by placing it on 220-grit sandpaper and moving it in a circular motion.

After the bottom and top of the piece are soldered in place and the excess pewter filed off, smooth the outside of the seams by wet sanding with 220-grit abrasive. Sand the entire piece with 400-, then 600-grit, sandpaper.

Next, set up a buffing wheel to spin at 3500 rpm. Apply Tripoli cutting compound and buff the pewter. Then reduce the wheel speed to 175 rpm and use polishing compound on the pewter. Keep the piece moving so it won't overheat. *Note:* wear a mask and cotton gloves.

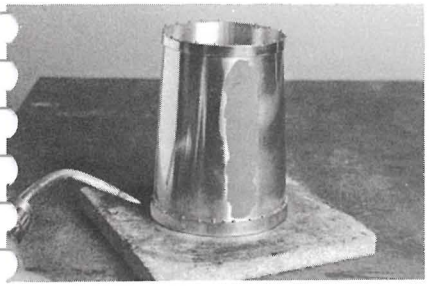
SUPPLIERS

Prices for pewter are constantly fluctuating. At press time, 1 sq. ft. of 18-ga. pewter costs about $30. Enough material to make each project is available from Guyot Designworks, Box 23C, Fly Creek, NY 13337. Approximate postpaid prices are: Fruit bowl pewter (wood base not included), $22.50; box pewter and solder (wood top not included), $7; salt and pepper shaker pewter, solder and two corks, $8.50; tankard pewter and solder (wood handle not included), $18. Write for current prices; make certain you include a self-addressed, stamped envelope.

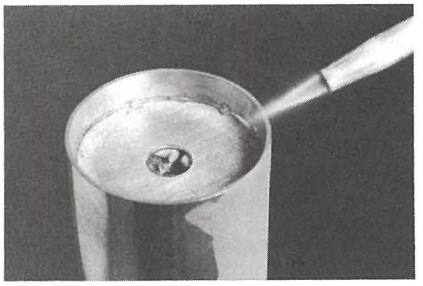
Anchor Tool and Supply Co. Inc. (tools, materials), Box 265, Chatham, NJ 07928 (catalog, $2).

T.B. Hagstoz and Son Inc. (tools, materials), 709 Sansom St., Philadelphia, PA 19106 (catalog free).

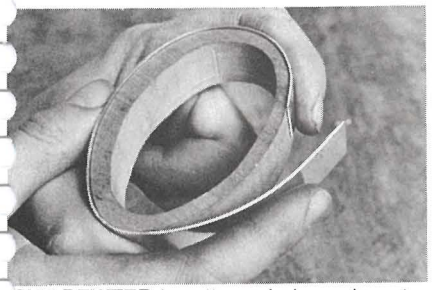
Modern Pewter, by Shirley Charron, gives helpful information about pewter designs and fabrication techniques. Litton Education Publishing Inc., 7625 Empire Dr., Florence, KY 41042.



POSITION trim piece to check fit. Remove and solder ends. File excess solder, reposition and solder to body.

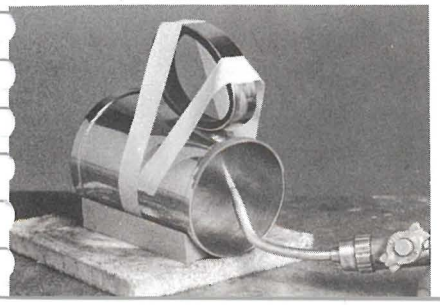


PUT WOOD shaker in vise vertically and slide cylinder over it, protruding 3/8-in. Insert and solder bottom piece.

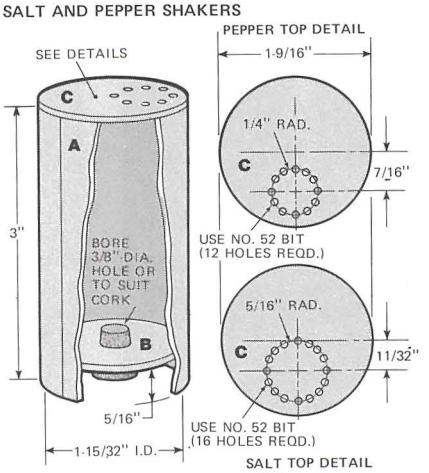


CUT PEWTER handle and cherry insert. Sand outer wood surface square. Bend around wood, remove and solder joint.

APPLY FLUX and solder, tape handle in place. Paint rim with ochre, then solder. Handle drops slightly as solder melts.



SALT AND PEPPER SHAKERS



MATERIALS LIST—BOX

Key	Pcs.	Size and description (use)
A	1	$1^{15}/_{16}$ × 9½" 18-ga. pewter (side)
B	1	3¼" dia. 18-ga. pewter disc (bottom)
C	1	¾ × 3½"-dia. cherry wood (top)

Misc.: 2⅞"-dia. × 4" maple cylinder form; tung oil; 2⅞"-dia. suede disc (optional).

MATERIALS LIST—BOWL

Key	Pcs.	Size and description (use)
A	1	10½"-dia. 18-ga. pewter disc (bowl)
B	1	1½ × 6¼"-dia. cherry wood disc (base); glue up 2, ¾-in. pieces
C	1	1⅝ × x 11"-dia. maple disc (form)
D	1	¾ × 12"-sq. plywood (form top)

Misc.: Glue, masking tape, tung oil.

MATERIALS LIST—SHAKERS

Key	Pcs.	Size and description (use)
A	2	3 × 4¾" 18-ga. pewter (side)
B	2	$1^{15}/_{32}$"-dia. 18-ga. pewter disc (bottom)
C	2	1¾"-dia. 18-ga. pewter disc (top)

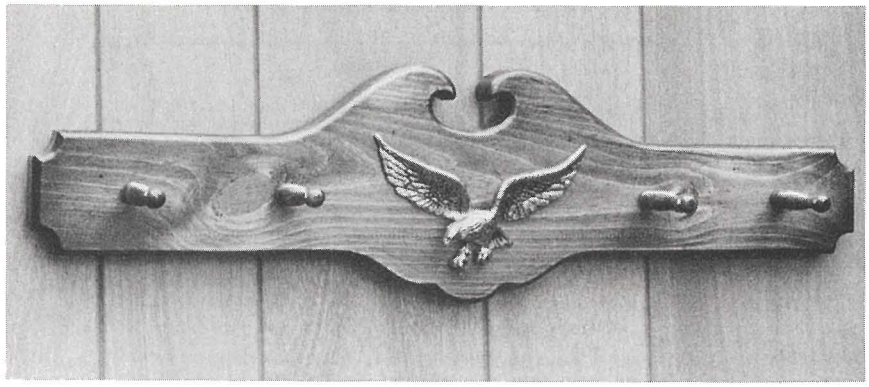
Misc.: $1^{15}/_{32}$"-dia. × 5" maple cylinder form, 2 corks (available in several sizes in hardware stores).

MATERIALS LIST—TANKARD

Key	Pcs.	Size and description (use)
A	1	$4^{11}/_{16}$ × 10¾" 18 ga. pewter (side)
B	1	¼ × 9½" 18-ga. pewter (top trim)
C	1	¾ × 11⅛" 18-ga. pewter (bottom trim)
D	1	3¾"-dia. 18 ga. pewter (bottom)
E	1	$^{13}/_{16}$ × 9½" 18 ga. pewter (handle)
F	1	¾ × 2½ × 3½" cherry wood (handle)

Misc.: Maple truncated cone form (use i.d. and height on tankard drawing; add extra height for vise grippage), glue, tung oil, masking tape.

Three quick projects for your home



By PETER CAPOTOSTO

A Place to Hang Your Coat

■ THIS ATTRACTIVE colonial wall rack will delight anyone who has ever picked up coats from doorknobs, floors, chairs, or banisters. You can make it in an evening.

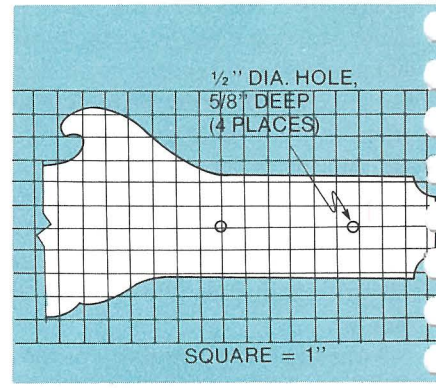
Lay out the pattern on paper, cut it out and trace it on the board. Using a sabre saw with a smooth-cutting blade, cut outline to size. If bandsaw is used, a narrow blade is needed for sharp turns at top.

Use a drill press or jig-guided portable drill to get true holes for pegs. Bore ¼-in.-dia. mounting holes 16 in. apart to locate over wall studs. Counterbore ¾ in. dia. and ¾ in. deep.

Assemble with glue, finish as desired, lagscrew to wall and plug counterbores.

MATERIALS LIST—COAT RACK

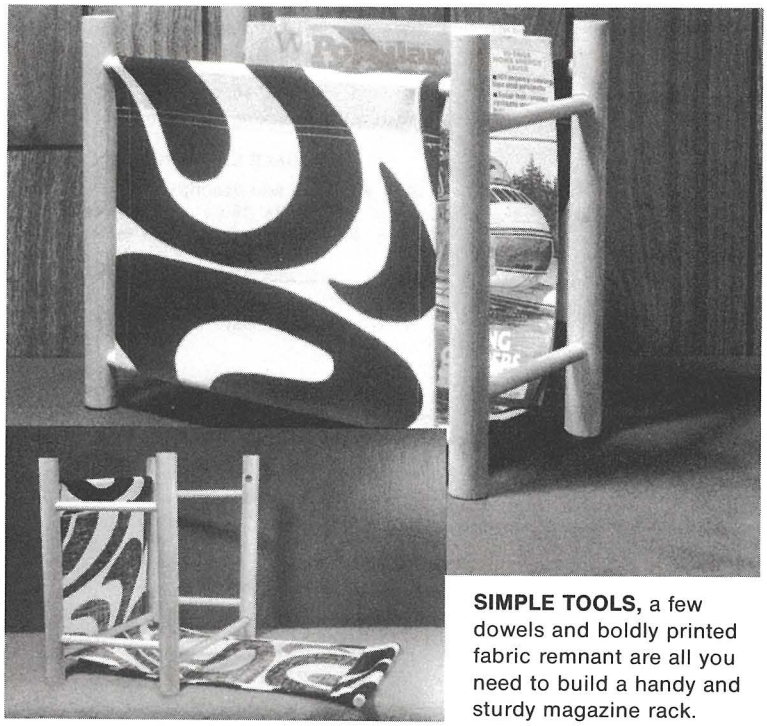
Misc.: 1½×10×34″ pine board, eagle ornament*, 4¾×4″ Shaker pegs*, 2¼×3″ lagscrews, glue, stain and lacquer.* Available from Armor Products, Box 290, Deer Park, N.Y. 11729.



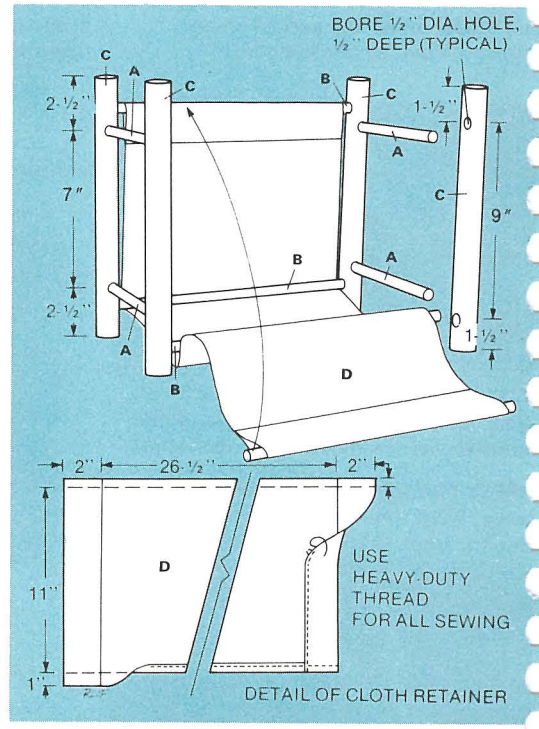
USE ROUTER with ¼-in.-radius rounding over bit to shape front edges of rack.

A Place for Periodicals

By KAREN HJEMBOE



SIMPLE TOOLS, a few dowels and boldly printed fabric remnant are all you need to build a handy and sturdy magazine rack.



A SAW AND DRILL are the only tools you'll need for this magazine rack. The fabric retainer can be sewn by hand or machine.

Use a V-block jig to position the dowels accurately for drilling. Be sure that the pairs of holes at each corner are bored at right angles to avoid a lopsided frame.

Assemble dowel frame with glue—except at ends of upper dowels (B). Leave these unglued until you're ready to add retainer. Finish dowels and allow to dry. Then carefully pull out one end of each upper dowel (B) and slip on fabric.

Editor's note: If friction fit of unglued dowels is tight, leave them unglued so you can remove and wash fabric should it become soiled.

MATERIALS LIST—MAGAZINE RACK

Key	No.	Size and description
A	4	½"-dia. × 6" birch dowel
B	4	½"-dia. × 12" birch dowel
C	4	1"-dia. × 12" birch dowel
D	1	13 × 30½" or to fit, cotton canvas, duck, denim or suede cloth.

Misc.: White glue, heavy-duty thread, stain, paint or varnish.

Make This Plate Butler For Your Cupboard

BRYAN M. VINCENT

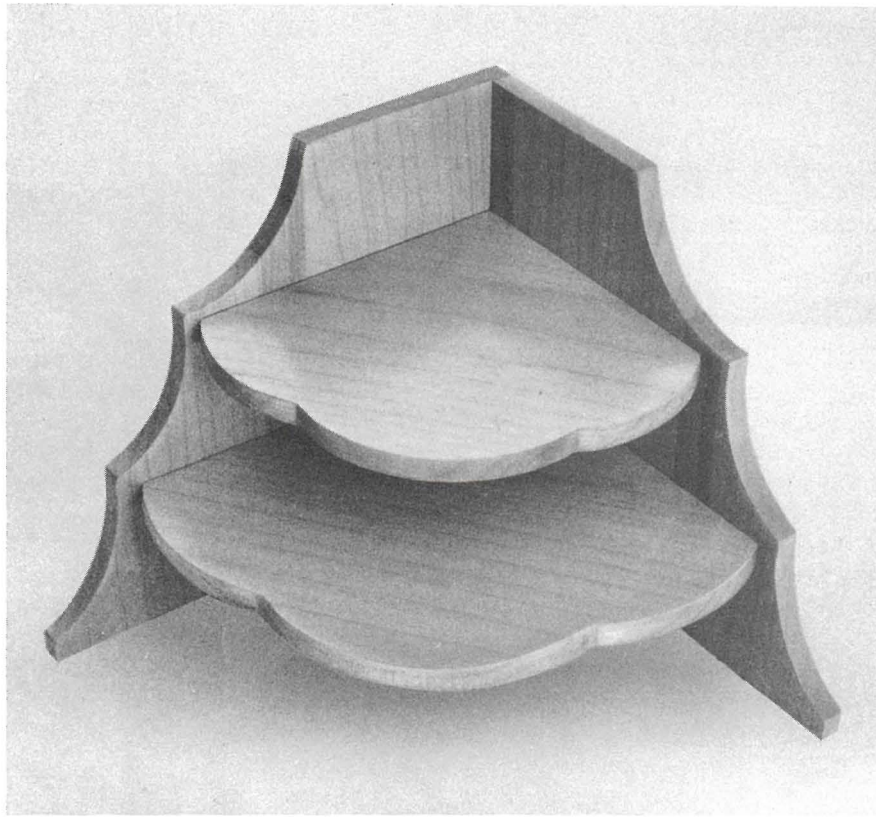
THIS MINIATURE set of add-on shelves for a cupboard lets you stack plates according to size, so you can remove or replace them quickly and easily. You can adapt the idea to stack saucers, fruit dishes and other pieces of tableware. Besides organizing your cupboards for easy access, the plate butler lets you store a greater number of items.

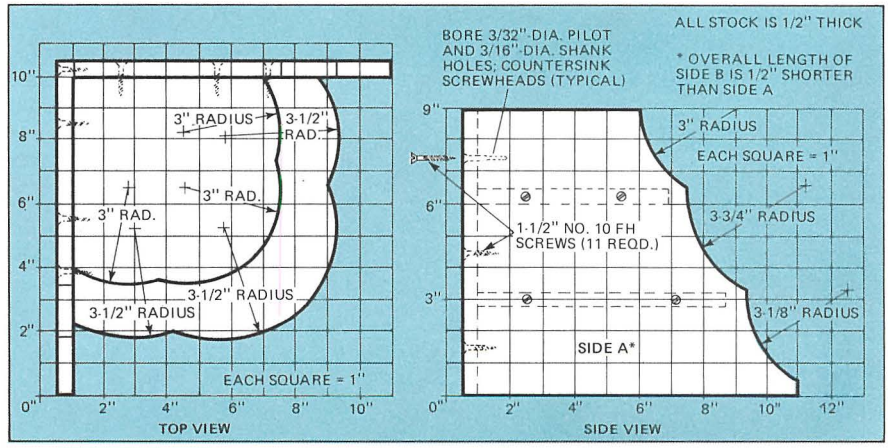
Any ½-in. stock, solid wood or plywood, is suitable for making the plate butler. The one shown is made of cedar and finished with lacquer. You can modify the plan to suit other plate sizes or accommodate more plates. Measure the distance between cupboard shelves to determine the maximum height you can make the sidepieces. All the joints are simple butt joints.

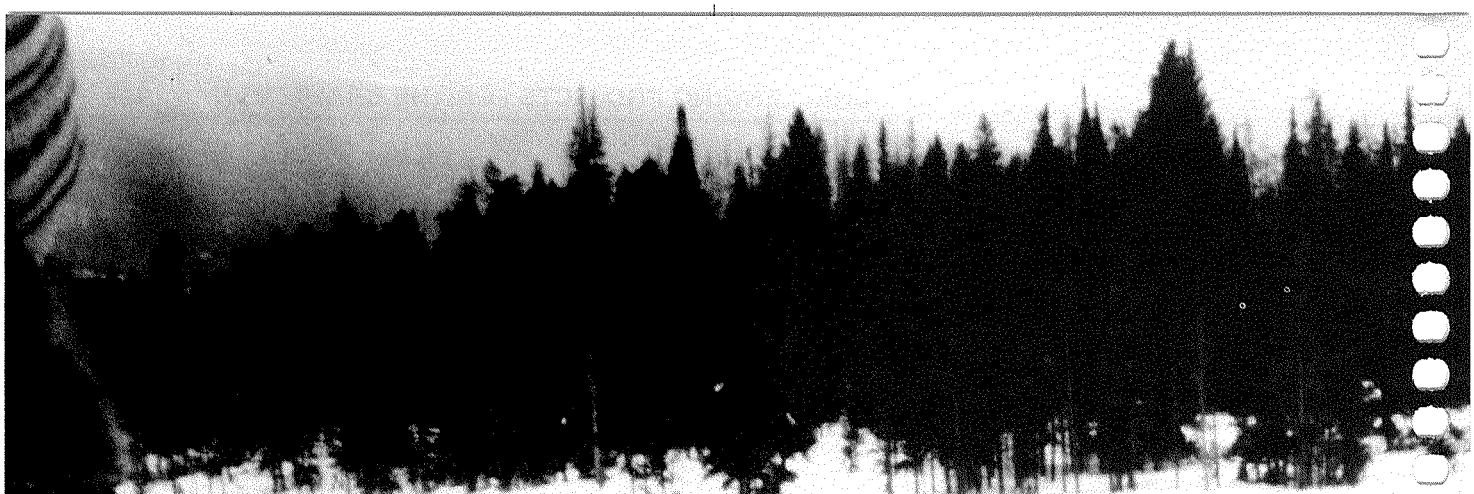
Begin work by measuring and marking a 1-in.-sq. grid on paper. To make the shelves, mark off the straight dimensions of each on the grid. Then locate the radii for the scallops. The curves on the sidepieces (A) are in keeping with the overall design, but may be omitted.

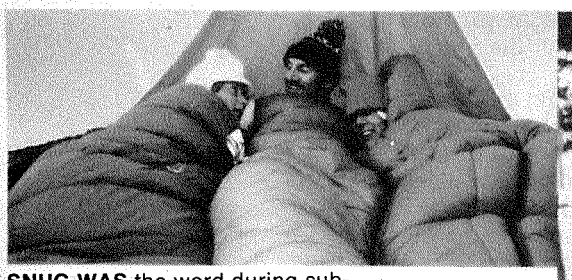
Use carbon paper and pencil to transfer the pattern to the wood. Cut out the pieces and sand the parts smooth with 80- and then 120-grit abrasive paper before joining. Dust off and use a tack rag to remove fine dust particles.

Join the shelves and sides with 11 1½-in. No. 10 flathead screws in predrilled holes. No glue is used, so the unit can be taken apart quickly for storage. Finish with spray lacquer, following the directions on the can.

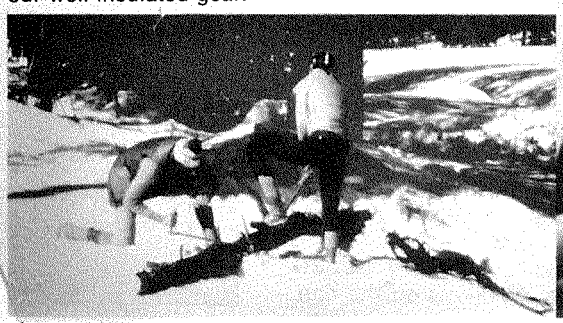




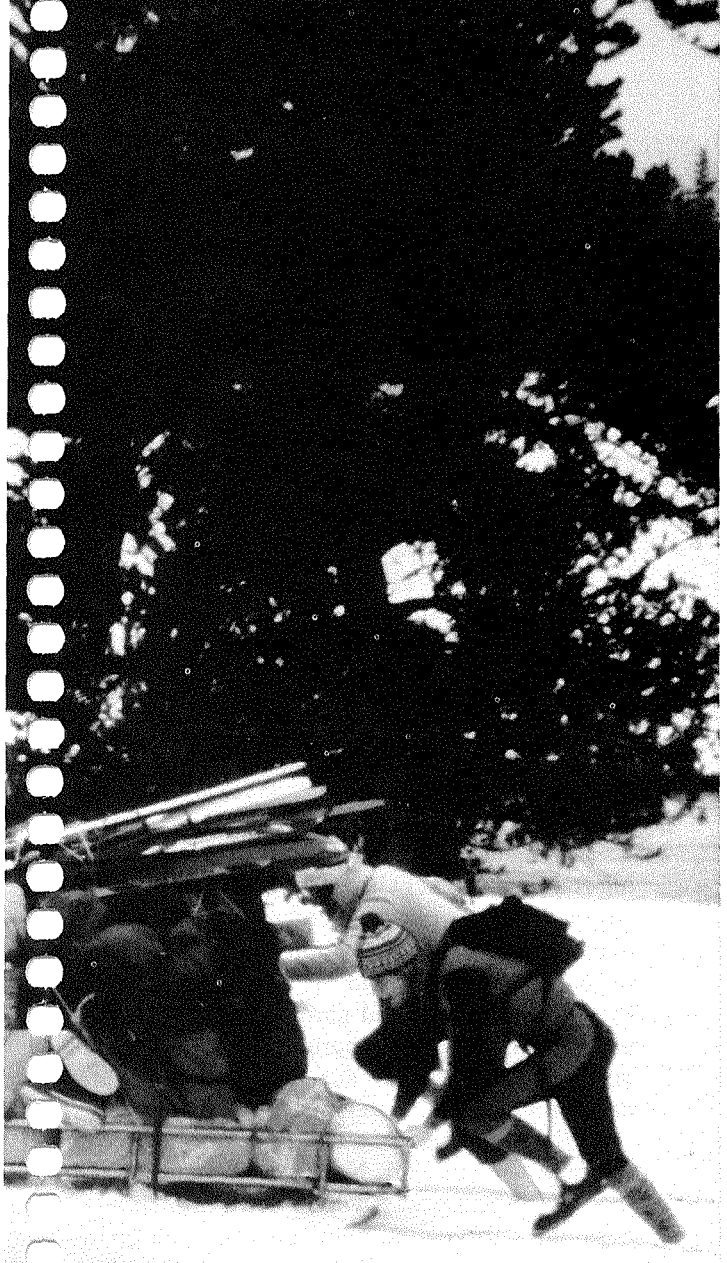




SNUG WAS the word during sub-zero Yellowstone nights, thanks to our well-insulated gear.



FINDING a good store of dead wood, the campers cut it to size with a folding saw.



CAMP, WITH FIRE and sparks well away from tent, was a home for man and beast, as wind whipped in a snowstorm.

Camping in the snow

Amid deep drifts and chilling winds this team finds that what used to be a survival situation now has become recreation

By JOHN ROSS JR.

THE SLENDER SKI tracks leading us back to our campsite in the snows of Yellowstone Park had turned treacherously slick. More than once I slipped and fell, as my skis refused to grip the frozen trail through the forest.

Five of us had entered these woods earlier in the day. We had followed a cross-country trail along the banks of the Snake River.

By noon our skis sluiced along as the snow melted under a brilliant high-altitude sun, and we stopped to eat our oranges and peel off another layer of clothing. The trail petered out by mid-afternoon, but after examining our topographic map, with its maze of contour lines, we estimated we could still reach Crawfish Hot Springs.

It could take another hour's skiing, however. Going on might mean cooking supper in the cold and darkness, so Hal Painter, our chief cook, started back to lay a warming fire and set the cookstoves ablaze. Sarah and Annie, two able-bodied skiers from nearby Jackson Hole, went with him, while Rob and I went on in search of the springs.

An hour later, there was no sign of it or of a trail. Reluctantly, we agreed to abandon our search. We considered heading directly for camp, rather than retracing our roundabout route, but there were no visible landmarks and I had left my compass in camp, thinking I wouldn't need it. Quickly, we agreed to return the way we came, cutting over a ridgeline to save time. From atop the ridge, the downhill part was a welcome prospect. Rob went first and, sliding along, he quickly gained speed. Then, suddenly, I heard a loud crack of wood breaking and Rob went sprawling in a tangle among the tree trunks.

He lay on the trail without moving. I shouted, and after a moment he called back, a little feebly. By the time I got down the glazed trail, Rob was on his feet. The basket of his ski pole had snared

WITH WINTER CAMP at center of the action, cross-country backpack tours circle back to camp by sunset.

ONCE UNLOADED of tents and sleeping gear, tow sledge became chuck wagon for stove-cooked meals.

a branch, he explained, and the wrist strap had thrown him in his tracks. But the only damage done, according to Rob, was a strained shoulder.

In minutes, he gamely skied off down the hill, and I couldn't help wondering what would have happened had he broken his ankle, or worse. Camp was still several miles away, and an emergency snowmobile from Flagg Ranch miles farther. People die in the national parks every year in similar circumstances. The serious side of snow camping in the wilderness began to sink in.

From the start, we were all aware of how cold it can get in the wilds of Wyoming. But even though Yellowstone is an isolated spot, with *proper* gear for eating, sleeping and traveling in the snow, camping out can be little more of a problem than it is in warm weather.

Nothing is quite so disabling or demoralizing as being continuously cold. When you can't warm up with protective clothing, warm food or a fire, you risk exposure chill called hypothermia, which can be fatal when body temperature drops to 80°.

Time was when only a few brave men, outfitted with sophisticated gear, dared long winter treks or mountain expeditions. Now, however, numerous improvements in new clothing and equipment for professionals have been adapted to recreational camping.

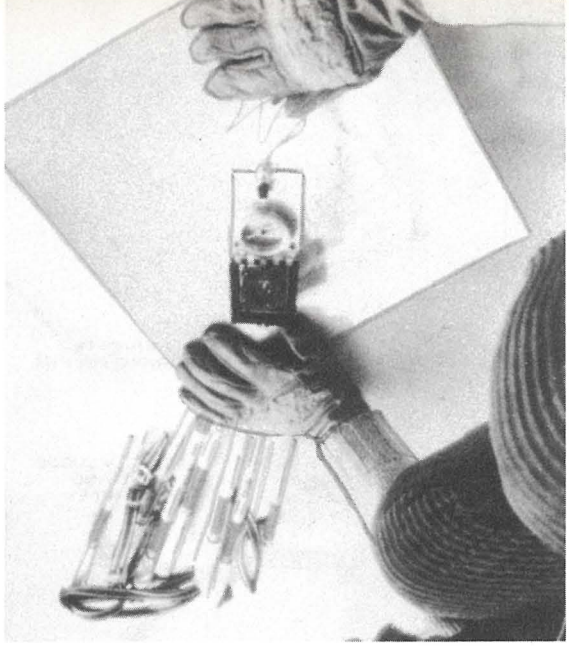
Coping with the cold calls first for layers of clothing. We appreciated this almost as soon as we left Flagg Ranch, where we had assembled our supplies, aided by Harry Baxter of the famous ski resort. Sunshine greeted us the day we set out by snowmobile and skis to establish our camp. We were lightly dressed in cotton turtlenecks, shirts and sweaters, but skiing with packs on had us shedding the outer layer by the time we'd found an ideal campsite.

Pitching tents, collecting firewood and readying cooking gear kept us warm. But as soon as we stopped work, we felt the creeping cold. Instead of donning an additional windbreaker, down vest or parka, we first had to take off clothing. Perspiration-dampened garments, such as long underwear and snow-encrusted socks, are undercover agents that act against the body's natural warmth.

At the initial sign of a chill, put on something dry next to your skin. Newest is polypropylene underwear and socks, which don't absorb wetness and can ventilate moisture through openings in the knitting. Cotton underclothes that wick will also work.

Our modest cooking was aided by reliable stoves: two compact Coleman Peak One models that were lightweight, fairly easy to light and not temperamental—as many campstoves are. Large pots of water boiled in a hurry without use of much fuel. We found that lighter fluid ignited around the burner helped start a cold stove quickly.

We kept our meals to handy one-pot specials. Boxed noodles, soup-mix in envelopes and seasonings made the basis for a hearty dish, to which ground meat or vegetables could be added. Supplemented by bread, cheese and wine, with a piece of fresh fruit for dessert, our quick-fix fare was ample. Besides making a main course loaded with carbohydrates, which the body quickly burns in the cold, the ingredients are easily backpacked. Most of our foodstuffs were chosen so they wouldn't freeze—a snow-



WHEN LANDMARKS disappeared under the snow, compass plotting was required before ski excursions.

camping consideration. Special dehydrated and freeze-dried pack-in foods solve that problem, but can be rather expensive. The old trick of burying food in an insulated bag in the snow will keep freezable items away from the colder outside air.

To protect ourselves from freezing temperatures during the nights, we selected tent sites carefully, pitching easily erected Coleman models of nylon taffeta and an unusual Holobar tent of rip-stop nylon that hoisted quickly on arched supports. When tent flooring rests directly on snow, the sleeping surface may feel as cold and hard as the sheet of ice below it. But somehow our thin Camp Trails sleeping pads of plastic foam saved us from the morgue-like slab of snow. With pads in place, we unrolled our sleeping bags. Some of ours were down-filled; others had DuPont's Hollofil II; all were rated for temperatures well below zero.

Around our after-dinner campfire we talked about other campsites—none anything like this—and our hosts from Jackson Hole mentioned a nearby "hot spot." Called Huckleberry Hot Springs, the thermal pools were said to steam and bubble up to overflow into the Snake River, only 15 minutes away.

Everyone was ready for a final ski in the dark, and soon we were basking in the sulfurous baths by the light of the moon. When it got too hot, we splashed into the frigid rapids of the river, and back and forth—a soothing way to end our first day in the wilds.

Later during the night I awoke from a sound sleep with a strange tingling sensation in my face. The night air inside the tent was so cold, I realized, that I would have to sleep inside the hood of the mummy bag with the drawstring pulled closed to expose only my nose and mouth for breathing.

But in the morning there were steaming mugs of hot chocolate and hot water mixed with granola, powdered milk, raisins and nuts into a warm, wholesome porridge that brought us back to life. For exploring on skis, we quickly learned that light day packs were best, stocked with lunch, compass, dry socks, sweater, windbreaker and a small kit of first-aid and survival supplies.

Snow-camp skills and gear

At temperatures below zero, outdoor living can be a survival situation. Whether camping by choice, or by chance—if stranded or lost—your life may depend on you're making the proper preparations.

- When exposed to cold, make sure all extremities are well covered. Warm gloves, a hat that pulls down over your ears and waterproof, insulated boots help cut heat loss. Spares are worth carrying in pack or car trunk for emergencies.
- Avoid getting wet from melted snow or the sweat of overexertion. Work methodically to keep dry and conserve energy.
- Don't ski or hike far afield alone. If someone is injured, a companion can go for help. Carry extra protective clothing, knife, matches, sunglasses, compass, chocolate bar, first-aid kit. Anticipate the worst circumstances you can imagine and mentally rehearse what you would do.
- Carry a ski-tip replacement or snowshoes in your car trunk and with your snowmobile, just in case.
- For shelter in a storm, build a windbreak or hollow out a snow cave with a small folding shovel. Keep a thick layer of snow overhead and cut a breathing hole through it.

When assembling equipment for snow camping, select:

Skis. Standard cross-country touring skis matched to your height and weight are suitable. A no-wax running surface, such as Trak's fish-scale design, performs well, as do Kneissl's and the patented Epoke 900 mica base from Norway.

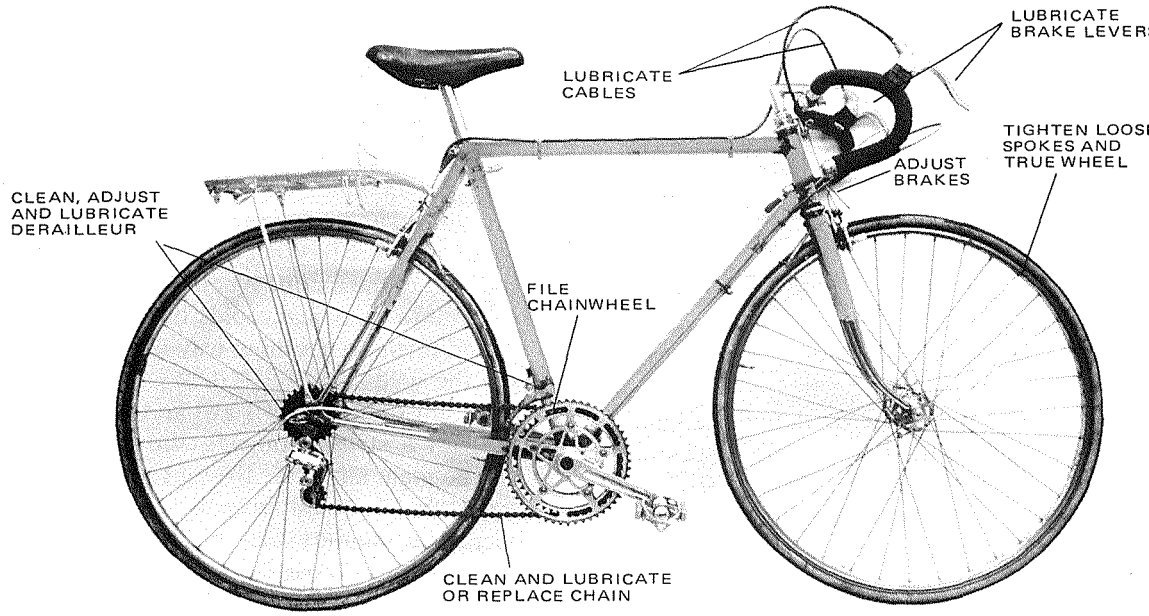
Ski equipment. Bindings, preferably the conventional 75-mm size, are strong. Boots should be high enough for ankle support,

Sleeping bags. We found hooded mummy models best, but the shape must allow room to move. Don't compromise to get light weight, instead of sub-zero temperature rating.

Tents. Small, light backpacking tents with waterproof floors are suitable. Coleman's Peak One free-standing models proved practical and easy to pitch. Holubar's Chateau three-man gave extra space for gear.

Clothing. Plan to wear layers, with dry underwear and socks to change into.

Equipment. Well-fitting packs, stove, ax, folding saw and shovel, regular camping gear. We took a wine skin filled with brandy—since camping is supposed to be fun.



By JOHN SCHUBERT

Tune up your bike

■ BICYCLES RUN almost forever without maintenance, right?

Wrong. There are many good reasons why you should spend the time and effort. Here are a few:

- **Safety.** About one-fifth of all bicycle accidents serious enough to warrant a hospital visit are caused by equipment failure, according to the Consumer Product Safety Commission. Some bicycles are so neglected that they're accidents waiting to happen.
- **Cost.** Most bike shops now charge $15 per hour or more. The tasks shown here would run $30 to $40.
- **Ease.** The bicycle is the world's most convenient machine to maintain in good repair.

getting ready

Look over your bike with this article in hand and make a list of everything you need for the jobs you'll be doing. You'll certainly need bearing grease and lightweight oil, and you may need kerosene for cleaning dirty parts.

Line up the tools you probably already have—needlenose pliers, large and small screwdrivers, wire cutters and an adjustable wrench. Arc-joint and locking pliers are always helpful. You'll also need some tools you probably don't have. If your bike is anything other than an American one-speed, you'll need metric wrenches, usually in sizes from 8 through 12 mm. A second 8- or 9-mm wrench may be needed to hold a bolt still while you turn a corresponding nut (see below). A $^{5}/_{16}$-inch wrench will fit an 8-mm nut.

You may need to go to a bike shop for a spoke wrench and a chain-link-removing tool. Get a tire-pressure gauge made for bicycles, too.

New parts may be in order—possibly new cables, cable casings, brake pads and/or a chain. All together, they should cost less than $10. If you have to replace missing spokes, take the wheel in to compare spoke size.

A bicycle repair book will probably tell you to disassemble, clean and repack your bike's ball bearings twice a year. That's fine, but do the jobs pictured here first. They're a lot more important. (Never take the halfway measure of oiling bearings. The oil washes the grease out, then goes away and the bearing is left unlubricated.)

start with cables

Your first and most important job is to inspect and grease your cables. Are they frayed and worn? Replace them before they fail at a crucial moment. If they are in good condition, you should still take them off the bike and grease them liberally (Photo 1).

Bicycles are frequently sold with cable casings that are too long. The extra length causes excess friction and slows brake response. If a casing is any longer than necessary to reach between its two end points in a smooth but small arc, remove the excess length (Photo 2).

about brakes

As a bicycle mechanic, I've been shocked by the poorly maintained brakes my customers trust themselves to. Brakes are such simple mechanisms that you should have no problem maintaining them. Disconnect the cables and see if your hand levers swing freely. If not, lubricate them (Photo 3). If the problem persists, bend them slightly sideways while swinging them. Add more lubricant.

If your brake pads have become worn unevenly by not striking the rim properly, buy new ones. Make sure they hit the rims squarely; adjust them if they don't. If your brakes squeal when you apply them, *gently* bend them so the fronts of the brake pads touch the rim first.

If you can squeeze the brake lever easily all the way to the handlebar, your brakes are too loose. Tightening them is often called a three-hand job (and a special tool called a "third hand" is often used), but you can do quite well with two hands. Take your needlenose pliers and grab the cable just underneath the brake's cable anchor bolt. Loosen the anchor bolt and twirl the cable around the pliers like spaghetti on a fork (Photo 4). This will draw the brake closed onto the rim. Now take a metric wrench in your other hand and retighten the anchor bolt (Photo 5). All cables, especially new ones, stretch some—so expect it.

If your brakes aren't centered over the wheel, causing one brake pad to hit the rim before the other, or one pad rubs all the time (assuming the wheel is not warped; see below), you can fix them as follows:

For center-pull brakes, loosen the nut that holds the brake assembly to the frame, rotate the assembly to proper position and retighten.

Side-pull brakes aren't as easy, until you learn the secret. For most brands, you'll need two open-end 10-mm wrenches, one of them made unusually thin by a visit to your grinding wheel. The single bolt on which the brake is mounted ends with two nuts holding everything together. Tighten those nuts against one another (Photo 6). Then, keeping one wrench on the two-nut assembly, put the other wrench on the mounting nut at the opposite end of the bolt. By turning your two wrenches in unison, you can rotate the entire brake (Photo 7).

caring for the chain

Depending on the care it receives, a chain may last thousands of miles or wear out in a week. A worn chain will shift sloppily and grind chainwheel teeth to an early death.

What happens when a chain wears out? Wear and tear on its many rollers make the chain too flexible. You can check your old chain for wear by seeing if an individual link can be picked up off the chainwheel teeth, while the links flanking it are still engaged. If you can pick the link up any more than ⅛ inch, the chain is ready for replacement. You can help your next chain last longer by keeping it oiled at all times.

If your chain isn't worn out, but is dirty or rusty, give it a kerosene bath. It's easiest to take the chain off the bike for this job. If your bike is a 10-speed, your chain has no master link, and you have to use a chain tool to disassemble it.

The chain tool pushes a link pin clear of the roller it normally engages (Photo 8). This allows the chain to come apart. Be careful not to push the link pin all the way out the far sideplate, or it will be all but impossible to push back in.

Bathe the chain in kerosene and put a drop of oil on each link. To replace the chain, reverse your moves with the chain tool—reassembling the link—then use the chain tool's special notch to force the chain link to bend slightly sideways (Photo 9). This is necessary to make the chain flex freely.

derailleurs not difficult

It's amazing that some people—including the authors of some bicycle repair handbooks—claim that a derailleur is too complicated for the

cyclist to adjust. In fact, there are only five things you can possibly do to your derailleurs, no matter how fancy or simple they are:

1. Clean and grease the derailleur cables and casing, as described earlier. Take up any extra cable slack.

2. If necessary, adjust the highgear adjusting screw. Every derailleur, front or rear, has one. Adjust it so the derailleur chain cage can easily engage the chain on the smallest sprocket (largest sprocket for the front unit), but can't throw the chain beyond the smallest sprocket into trouble.

3. Adjust the low-gear adjusting screw in much the same way.

4. Using cotton-tipped swabs dunked in kerosene, clean the entire mechanism. Lubricate it so it works freely through its full range of motion. If it's a mess, take it all apart and give it a kerosene bath.

5. In the case of the rear derailleur, you can apply extra lubrication to the two chain rollers so they spin freely.

For the front derailleur, you may want to bend the chain cage slightly (they aren't bent to the optimum shape at the factory). Bend both sides of the chain cage's nose inward about 1/16 inch (Photo 10). That will make the chain cage toss the chain around more aggressively. Position the front derailleur no higher on the frame than needed to clear the large chainwheel by a few millimeters.

filing chainwheel teeth

If you've worked on your chain and derailleurs and still have front shifting problems, you may have dull chainwheel teeth. Chainwheel teeth should have a pointed profile, and expensive chainwheels are carefully machined to the proper shape. If your chainwheel teeth were not, you can dress them nicely with a file (but don't do this to aluminum chainwheels, and don't do it to a Schwinn because Schwinns have never needed this fix).

The classic symptom of dull chainwheel teeth occurs when you're riding in first gear and the chain spontaneously derails to the inside. Some mechanics try to fix this by adjusting the front derailleur so it constantly rubs the chain, forcing it to stay on the chainwheel. That's wrong—the front derailleur should touch the chain only during shifts.

Fix as follows: Remove the chain from the chainwheel. Wedge a fairly fine flat file between the two chainwheels so it grates on the smaller chainwheel, sharpening the teeth (Photo 11). Rotate the crank for a minute or so, removing about 1 mm of metal from the side of the teeth. You'll grind off the chainwheel's chrome plating, but oil from the chain will continue to ward off rust.

Result: The chainwheel teeth will snag the chain, instead of allowing it to walk over them in a path to permanent derailment. If you have trouble with the large chainwheel snagging teeth, file it, too.

truing the wheels

As your bicycle is ridden, spokes stretch and the wheels acquire potato-chip-shaped warps. Truing a wheel is much easier than most people believe; it takes only about five minutes, with a little practice.

First, mark where the warps are. Deflate the tire and hold a crayon or piece of chalk next to the rim and spin the wheel, so the rim rubs the crayon during its erratic swings. Now correct the warps by slightly tightening the spoke nipples on the side you want the rim to lean toward, while loosening the spokes on the other side (Photo 12). Do an equal amount of loosening on one side, for all the tightening you do on the other, and do everything in increments of a half-turn of the spoke wrench. Be patient—you'll soon get the hang of it.

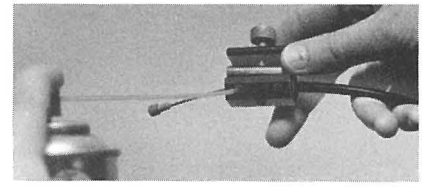
Greasing a bike cable

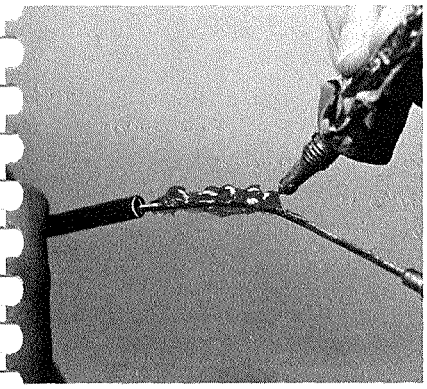
Greasing bicycle cables is drudge work, but it's even worse on a motorcycle, where removing the cable from the casing is more inconvenient.

Yamaha sells a time-saving cable greaser called the Power Cable Injector. The tiny device wraps a tight rubber collar around the cable and casing, with a small orifice for snorkel-tube lubricant. Insert the tube, push the button and the lubricant is forced down the length of the cable. In seconds, excess lubricant drips out the far end of the cable.

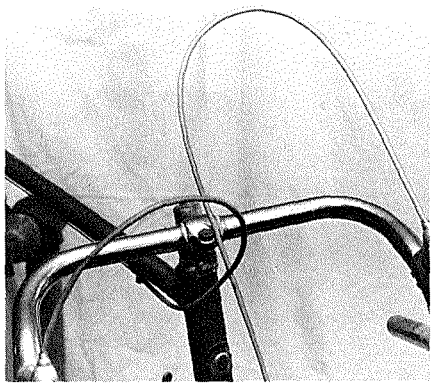
The Power Cable Injector is designed to accommodate a wide range of cable sizes. Motorcycle cables are much bigger than bicycle cables, but the tool fits all without leaking.

The injector worked well on bicycle cables, but we had two complaints: It commits you to snorkel-tube lubricant, when ordinary grease does a better job, and it costs $4.50—more than the occasional bicycle mechanic might want to spend. But, if you have a garage full of bicycles, motorcycles, snowmobiles, mopeds and so on, you'll find the Power Cable Injector to be well worth the investment.—*J.S.*



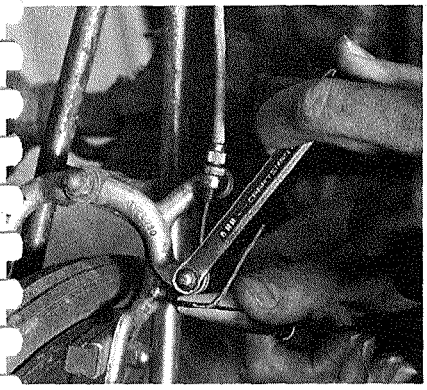


1 **GREASING** cables may not be fun, but 's essential for safe biking. Don't be afraid to slather on lots of goo.

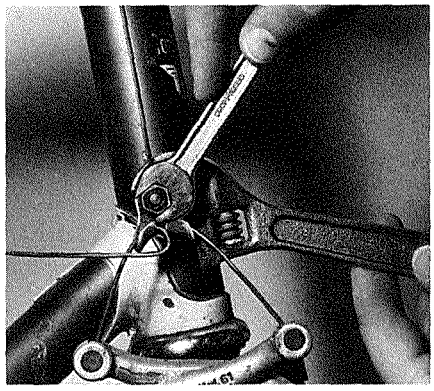


2 **YOUR BIKE** may have cables as long as one on the right, but they should be shortened like the one on the left.

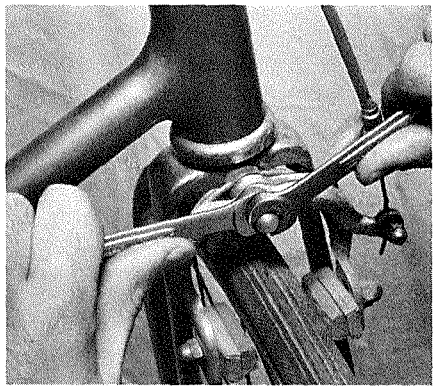
3 **STICKY** brake levers should be sprayed with lubricant. If they still stick, bend a bit sideways and relubricate.



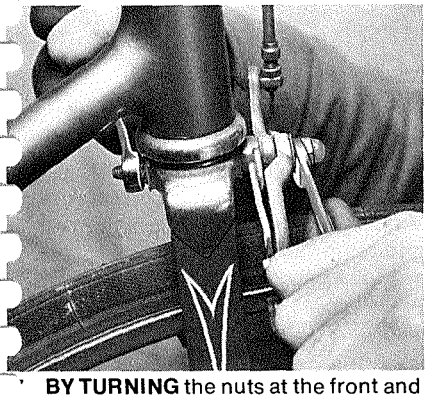
4 **TO TIGHTEN** a brake cable, use eedlenose pliers to twist it. Tighten the cable anchor bolt with a wrench.



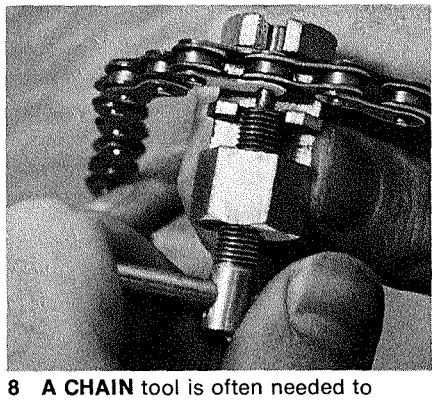
5 **TO FINISH** the job, use two wrenches to tighten cable anchor bolt. Be gentle, so you don't strip the threads.



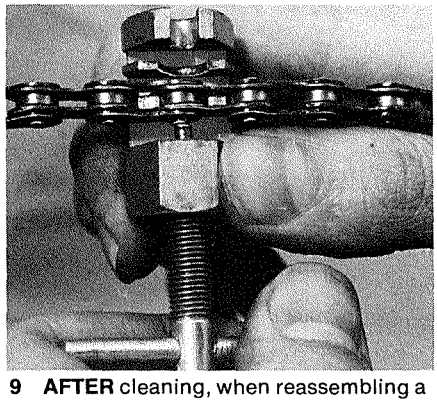
6 **FIRST STEP** in centering a side-pull brake is to tighten the two nuts in front of the brake against one another.



7 **BY TURNING** the nuts at the front and rear of the brake in unison, you can easily center the brake over the wheel.

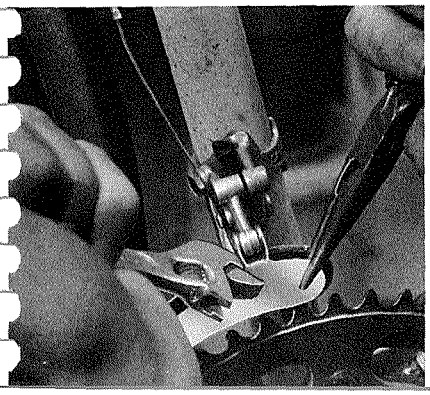


8 **A CHAIN** tool is often needed to remove the chain. Use tool to push out a link pin, but not all the way.

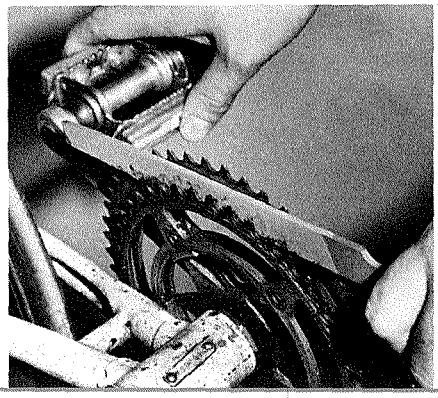


9 **AFTER** cleaning, when reassembling a chain with chain tool, use tool's inner notch to flex chain link sideways.

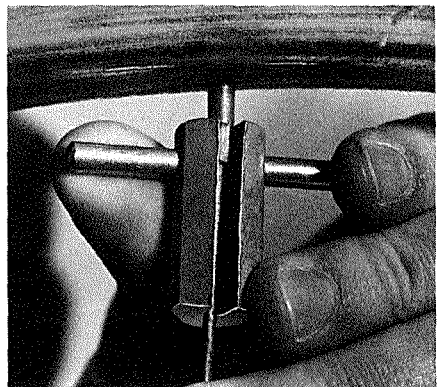
10 **BEND NOSE** of front derailleur cage slightly inward. The adjustable wrench keeps rest of cage from bending.

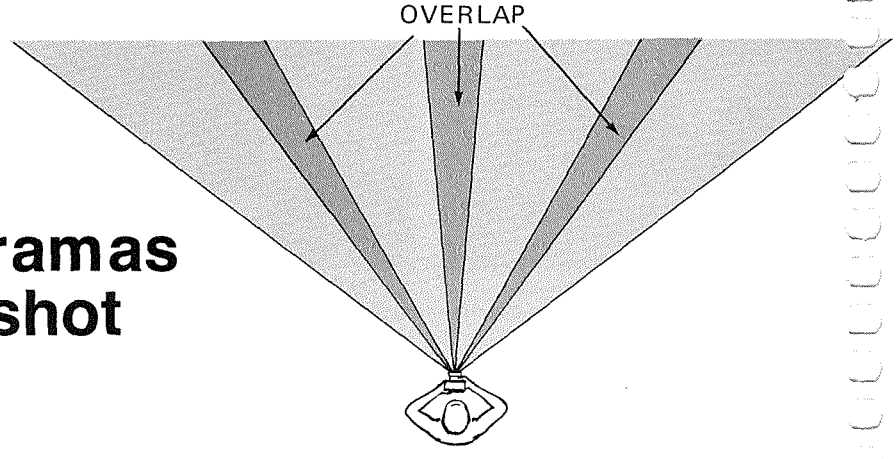


11 **IF CHAINWHEEL** teeth need filing, place file between chainwheels, turn crank. Don't file aluminum parts.



12 **INEXPENSIVE** spoke wrench eases wheel truing. Tighten or loosen opposing spokes in half-turn increments.





Shoot panoramas with a snapshot camera

Punch up your snapshots by turning them into panoramas. The panorama at the top of this page was shot using an ordinary 35-mm camera. The secret is in splicing the photos after they have been printed

HOW TO OVERLAP shots for panorama. It's sometimes possible to move parallel to the scene and take all shots head-on, but often there's not enough room to move around. Also, object sizes in photos may vary, preventing the proper alignment of adjacent photos.

By TOM SAHAGIAN

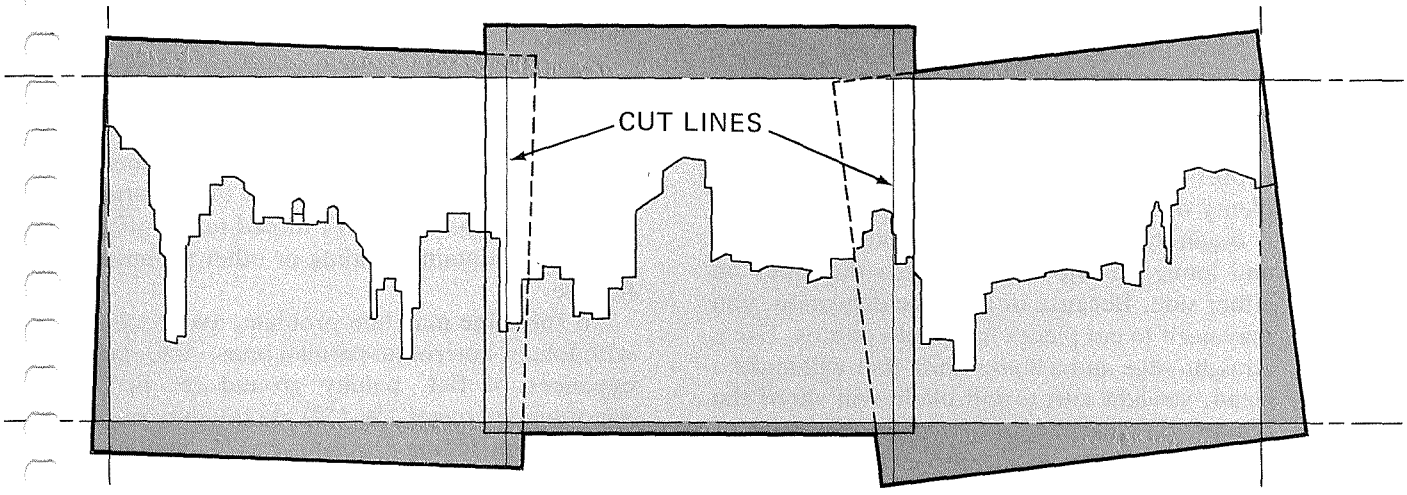
HOW OFTEN have you trotted out a snapshot album only to be disappointed by the dullness of many of the photos? Have you wished for pictures that showed the sweep of a city skyline, the breadth of a rolling valley or the stretch of a winding road—in short, a panoramic view of the world?

One way to take such pictures is with a $1000 panoramic camera. If that isn't possible, there *is* an alternative. You can make panoramic pictures yourself, even with a snapshot camera. The results won't equal those obtainable with a camera made for the purpose, but they will give your snapshots a new dimension.

taking the pictures

Pick a scene you think would lend itself to the panoramic format. While skylines and valleys are naturals, many ordinary scenes take on added drama when photographed panoramically.

While standing in the same spot, take several shots of a given scene in sequence. Don't be afraid to overlap the shots as much as 25 to 30 percent. Although it is not necessary, perfectionists may want to use a tripod. This will help



THE PANORAMA above was shot with a 35-mm SLR, but similar results are possible with a 110 camera. Careful scrutiny reveals seams and some unavoidable mismatching where photos meet, but overall effect is impressive. The diagram (above) shows how photos are matched. Few remain uncut; the matching process involves repeated cutting and trying. Do your experimenting with unimportant photos to become familiar with the technique. Once you've learned the procedures, try your hand at your best photos. Careful work should yield good results.

maintain the camera level to the ground and make for steadier shots. You can make later alignment of the photos even if you fasten the camera to the tripod with the center of the lens directly over the tripod screw. This can be done with a flat strip of metal with two holes drilled and tapped, so that the camera bolts to the strip and the strip bolts to the tripod with the center of the lens directly above. Rest assured, however, that perfectly acceptable results can be readily obtained with hand-held shooting. The panorama at the top of this page was done without a tripod.

The best time of day to do your shooting is around noon. This is because the lighting is more uniform at this time of day. For panoramas of only two or three shots this is not as crucial.

Taking photos for panoramas is easy; mounting them in an attractive way is a bit more difficult. Successful mounting is mostly a function of patience and thoroughness. It's almost impossible to achieve perfection, but the difference between a rush job and a careful one is painfully apparent.

essential materials

To start, assemble all necessary tools and materials on a large, flat work area. A drafting table is perfect, but a table or countertop will suffice. You'll need, besides your photos, a sharp knife

(like an X-acto knife), cardboard, clear cellophane tape, spray glue, a straightedge and a cutting surface. A T-square and triangle are helpful, but not essential. Since you'll be spraying glue around and cutting up photos, protect the work surface. And work with clean hands.

To have a preliminary idea of how the panorama will look, arrange the photos you've chosen so they present an unbroken scene. There will be some overlap, of course, Few, if any, snapshots will match up against other photos without any overlap because the inevitable distortion in a picture is most pronounced at the edges. You'll also notice that the photos don't line up parallel, but are at slight angles to one another. This also is caused by distortion.

patience needed

Now that you have an idea of what the panorama will look like, you can begin the final cutting. This step requires the most patience. It is perhaps chores like this that produced the expression "cut and try," for you'll be doing plenty of that.

Begin by taking the middle photo of the group and lining up one of the photos that goes on either side. Because of the edge distortion, you may need to cut pieces from both photos. Use a straight-edge and a sharp knife that will make a clean, straight cut; a dull blade will shred the border.

Once you've made the proper cuts, use a small bit of tape to hold the two photos in place. You can tape them to some scrap cardboard for now. Cover as little of the photos with tape as possible. Continue cutting and arranging and taping until the photos are lined up in their final positions.

Although you now have an unbroken panorama in front of you, the outer perimeter is quite jagged. To have a rectangular panorama, some additional cutting will be needed. Here a T-square and triangle will come in handy, but careful measuring and cutting will yield an equally good result.

cardboard works best

You may mount your panorama on just about anything, although cardboard is easiest to find and to work with. For extra stiffness, or if you want a good-looking border, matte board is excellent. Some people simply tape their photos together, with the extra tape holding the photos to the mounting surface. But this is ugly. Better to use spray glue (available in art supply stores and hobby shops). Make sure you spray the backs of the photos evenly, especially along the edges. Otherwise, the edges come unstuck and curl up, which is uglier than tape. After the photos are mounted, carefully clean the surface of the panorama. Cover it with a cloth and put some heavy books on it for a while to make sure the glue sticks. Remove the books and you will have yourself a most intriguing new dimension in snapshots.

some tips

While you're doing all that cutting, you'll quickly discover the two most irksome problems with this method of panorama-making. There are visible lines where the photos butt, and it is virtually impossible to line up two adjacent photos perfectly. Luckily, both problems can be minimized.

The ugly lines are most pronounced where sky meets sky and with other light-colored areas. The obvious solution is to frame your photos so there is not much sky in them. But remember to leave enough so that when you cut the panorama into a rectangle you aren't forced to cut off the top of a mountain, building or other prominent feature.

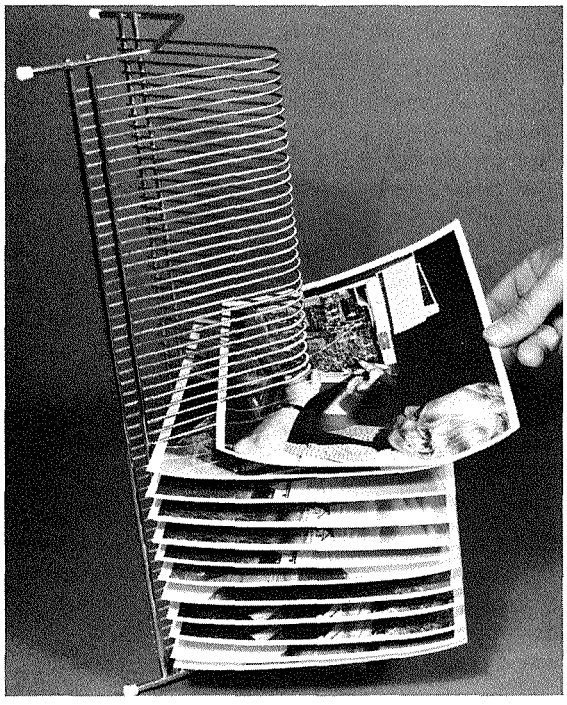
To solve the matchup problem, avoid scenes with lots of horizontal parallel lines. Also, large expanses of flat, patchy ground (as in the panorama on pages 156-157) are tough to match up. Many matching problems can be eliminated by cutting and butting photos along heavily shadowed areas or along natural verticals like tree trunks or the line where two buildings meet.

panoramic rewards

The above procedure may sound like a lot to work, but it's not. Neither is it something that takes five minutes. It takes a bit of practice, but the necessary skills are easily acquired. The best way to learn is to experiment with different techniques. Take some photos of your house or the block you live on and make a practice panorama or two. Start out with a two or three-picture panorama. As you become more proficient, you'll want to try spreads of four, five, six or more. Once you achieve even greater expertise, you can make even larger ones.

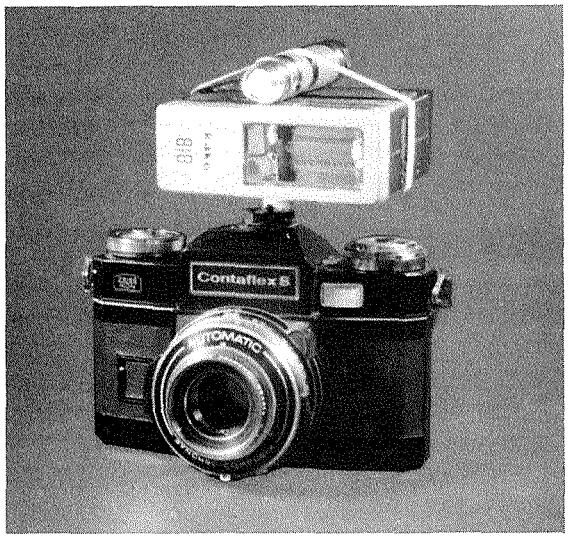
Any camera can be used to take panoramas, from a 110 pocket model to an 8x10 view camera. The same principles apply. While you won't be able to duplicate the results available from a special camera, they'll be good enough—and in a way, will be more fun.

Photo hints



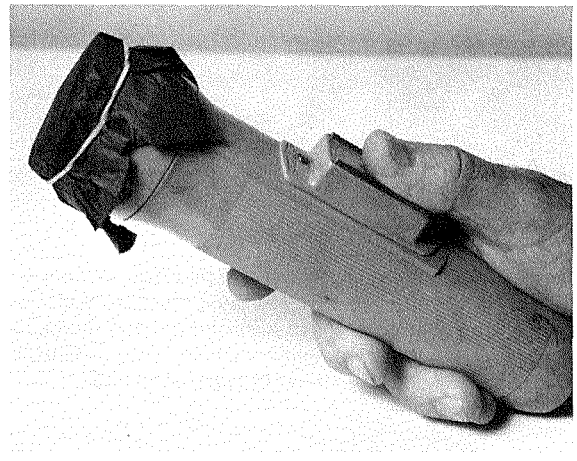
DRY RC PRINTS ON RECORD RACK

RESIN-COATED (RC) enlarging papers require little washing time; in fact, the less time they are wet, the better. Finding a place to dry them is sometimes difficult, but this rack should solve the problem. Stand a record storage rack on end as shown and place prints between the metal separators. If you find the prints tend to touch one another, use every other slot.



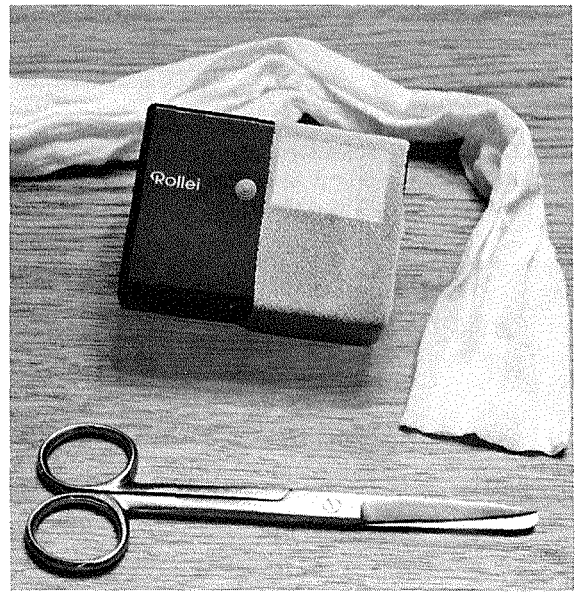
REDUCE PORTRAIT GLARE

PORTRAITS of people wearing glasses, when taken with a flash, can be spoiled by reflections in the lenses or frames. To avoid this, attach a small flashlight to the flash unit with elastic. The lighted bulb can be seen as a spot of light on the glasses. Adjust the flash or the person's head until the light spot can't be seen through the viewfinder; you'll find your portrait will be glare-free.



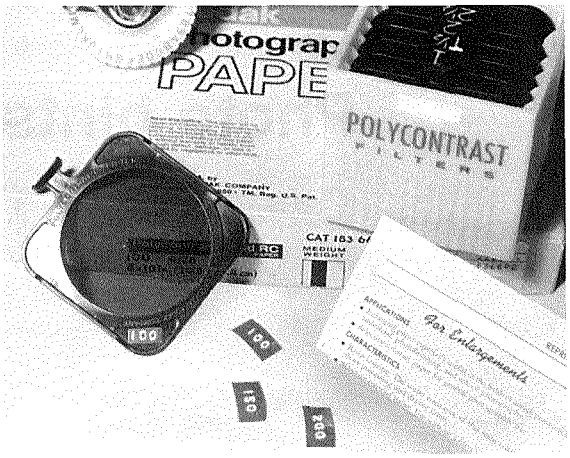
SEE IN THE DARKROOM

A FLASHLIGHT fitted with a hood of yellow or red plastic gift-wrapping makes a portable safelight for finding objects or checking equipment.



STOCKING SERVES AS DIFFUSER

A PIECE of a nurse's white stocking is a good substitute for a hard-to-find plastic diffuser for your flash unit. The elastic material holds in place nicely, takes up little space and is easily replaced. Flash guide number will drop to about .7 of its original value; experiment for more accurate measurement.



MARKED FILTERS SAVE TIME

IF YOU use an enlarging meter and poly-contrast paper in the darkroom, you know you must reset the meter's ANSI rating (similar to film's ASA rating) each time you change filters. To help remember which rating goes with what filter, use a label maker to mark each filter.

LABLES THAT DON'T COME OFF

MAKE waterproof labels for darkroom bottles with 2-in.-wide adhesive tape. Use ballpoint pen for marking; felt-tip writing usually washes away.

JUGS FOR DEVELOPING

TWO-GALLON plastic jugs can be cleaned out to make rockable 8×10 developing trays. Handles make agitation easier. Spouts reduce spillage when you pour back chemicals.

LENS-MARK LIGHTENER

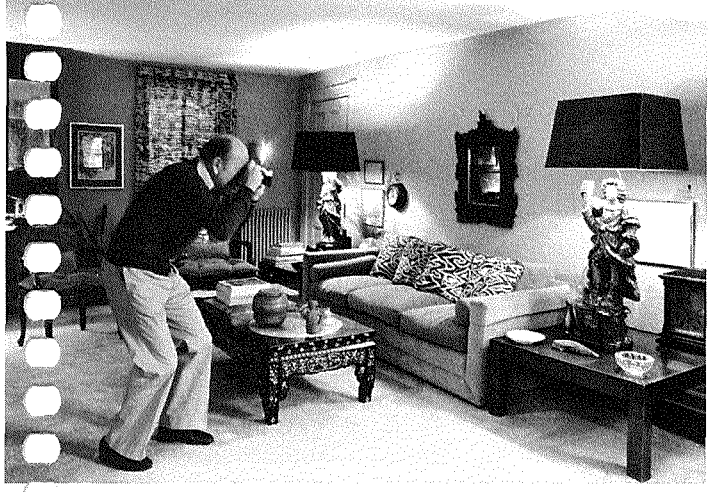
INDEX MARKS and other engraved lines and characters on a lens barrel can be made more visible through the application of light-colored lacquer. Try the white fluid used to correct typing mistakes. Apply with small brush or toothpick.

CAMERA SAFETY BELT

MAKE a strong but inexpensive camera strap from 1-inch nylon belting and two harness snaps from dog leashes. Loop the belt ends through the snaps about 2 inches and secure with epoxy and several rows of strong stitches.

BETTER THAN A POCKET

FILTERS, cable release, lens tissue and other small accessories are easily kept ready in a zippered tobacco pouch. Sew leather or webbing strips to form belt loops.



Make a photo inventory of your home

By ELIZABETH A. MARCHAK

■ AT LEAST once every minute, fire guts a home somewhere in the United States. Even if all the occupants escape unharmed, property damage is staggering; what's worse, most homeowners recover only a fraction of the value of their possessions, because they can't remember all of what they owned and can't prove they owned what they do remember.

Similar difficulties arise from losses involving flooding, theft or even negligence claims. Experts agree that the surest way to recover maximum value of stolen or destroyed property, or to protect yourself in a negligence suit, is with a photographic inventory of your home and your possessions.

inventory is easy to make

Not only is an inventory valuable, but it's easy to make, even for an amateur. Just about any camera can be used, although a single-lens-reflex (SLR), with interchangeable lenses, is considered most versatile.

To be most useful, a photographic inventory should be in color. Black and white photos are of limited value, especially when the color of an object is important in determining its model or worth. For example, an insurance adjuster would only have your word that your ruined Wedgwood vase was the more costly yellow jasper and not the light blue it would appear to be in a black and white photo.

slides are preferred

With color, the choice is between prints and slides. Prints are bigger than slides, don't require projection and are readily duplicated. But slides are cheaper, often provide more accurate color, and are preferred by some insurance agents precisely because they can be projected and thus made large.

Overcast weather provides ideal uniform light for all exterior (and many interior) shots. Overall views of all sides of your house should be taken with a wide-angle lens, say 24- to 28-mm with an SLR. Shoot both in summer, when shrubbery and flora are at their peak, and in fall, when bare trees reveal maximum view.

A normal lens can be used to photograph detailed woodwork in doors, around window frames and along eaves. These shots are particularly important with older homes, because the ornate woodwork enhances the value.

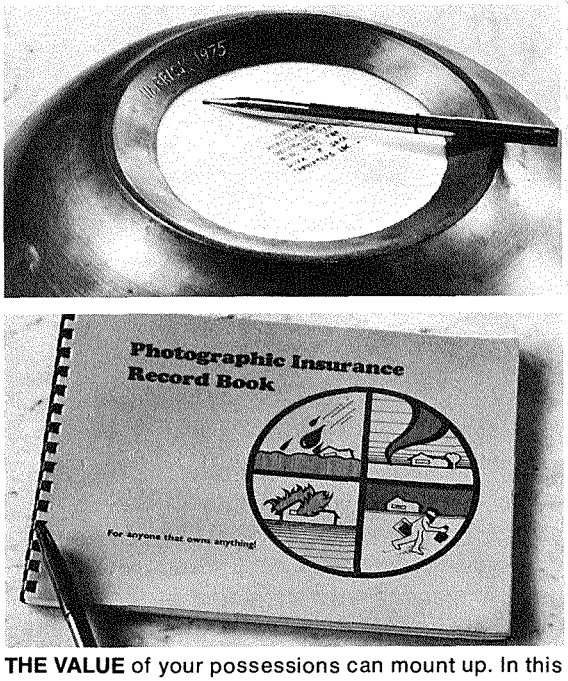
photograph the roof

While outside, photograph the roof to show the type of shingling. Don't forget to record the drainpipe system, flashing on the roof edge, signs, lanterns or TV antennas.

Other objects frequently forgotten include lawn furniture, swimming pools, expensive landscaping, cars, bicycles, lawnmowers, snowmobiles, garden equipment, storage sheds and garages. If the garage has an automatic door opener, take a picture of that, too. Overall shots of the property showing the relationship of house, trees, fences and so forth will come in handy in the event of a bad storm or negligence suit.

The diffused light of an overcast day will also work well for many interior shots, but a flash unit may be necessary to fill in a dark corner or as a primary light source. When using flash, especially for close-up shots, make sure the subject isn't closer than the distance setting on the unit. Otherwise, such shots will be grossly overexposed.

Each room in your house requires at least five photos: one for each wall, plus an overall view from a corner (a wide-angle lens is particularly useful here). If there are valuables in the room, however, the work is just beginning.



THE VALUE of your possessions can mount up. In this picture alone (left), it's more than $400. Mark valuables with a diamond scribe (top photo) or other tool and take a photo. Albums are available for organizing photos (above).

shoot antiques separately

Antique couches and chairs should be shot separately against a plain background (like a sheet or tablecloth) to highlight color and details. Paintings should be photographed outside in natural light for best color reproduction.

A collection of figurines or other small objects can be photographed together. If the pieces are extremely valuable, individual shots revealing special markings or colors should also be taken. Shoot hallmarks on plates, statues and other valuables.

other hints

- When photographing an object, you should also take a picture of any engraved identification numbers on the bottom or back. In fact, if you haven't already done so, it's a good idea to make such engravings now.
- Be certain to shoot both speakers of a hi-fi set, both with and without the grille cloth.
- Silverware and jewelry can be shot while laid out in a drawer. A closeup of the stem pattern or other identifying markings should be taken. Establish whether the pieces are sterling, silverplate or stainless.
- Photos of miniatures and small valuables should be shot with a standard measure (like a ruler) included to better identify the size and number of objects. A ruler in the picture is useful in many photos.
- In the kitchen, it's doubly important to record make and model numbers, since so many appliances of widely differing value look alike.
- Don't use direct flash on items like television sets, glass-doored cabinets, shiny-enameled appliances and other objects that will cause glare. Either bounce flash off white ceiling or shoot at 45° angle.
- Remember to photograph all the things in the basement and attic, including tools, seasonal sporting goods, boiler, water heater, oil tank and storage freezer.
- Don't forget special flooring, wallpaper or lighting fixtures.

identify each picture

Once the film is processed, each picture should be clearly identified in terms of date taken, color, style, model, date of purchase and condition of object. Description and photos should be kept in a safe-deposit box, perhaps with a copy at work. Never keep information at home. Never give negatives to anyone.

If you need a more formal format to display your prints, a photographic insurance record book is available from Porter's Camera Store, Box 628, Cedar Falls, IA 50613.

How to stop turntable rumble

By IVAN BERGER

Wild, growling noises from speakers can be quieted by taming a turntable's shakings and vibrations

■ EVER HEAR a public-address system ring or howl when the volume is turned up? That's acoustic feedback at work—and the same thing may be happening to your hi-fi or stereo system.

Acoustic feedback occurs when sound vibrations from speakers are picked up (by your turntable at home or by the microphone in a P.A. system, for example), amplified, and sent out through the speakers again, louder than they were at first. In extreme cases, it causes an identifiable howl—but even when you can't hear it directly, it can make your bass sound muddy.

But don't worry if you think you have this problem. It's easy to identify, and needn't cost much to cure.

how to recognize feedback

Unless you have old, vacuum-tube equipment that can pick up external vibrations, only your turntable can cause feedback. Turn the system to "phono," but on a record (with the needle in the grooves but the turntable motor off), set your volume a little louder than you normally have it, and tap the edge of the record *gently* with your fingertip. If you hear a smart "thud" that instantly dies away, you don't have feedback. If there's a slowly dying hum or howl after the thud stops, then you do have it.

Turning up the bass control will usually accentuate the problem; turning it down may make it go away. As a final check, lift the stylus gently from the record (use your system's cueing lift if it has one). The hum should go away as soon as the stylus rises from the record.

curing it for free

You may have already spotted an easy cure for feedback in our diagnostic technique: Lower the bass level and feedback will lower, too. If your system has a low-filter control, try switching that in instead. Low filters work on only the lowest bass tones (which don't occur often) and don't affect the whole bass region as bass controls do.

*Sub*sonic filters probably won't do the job, because feedback usually occurs at higher, audible frequencies. In our system, in fact, a subsonic filter actually increased feedback sensitivity.

If your controls won't do the job, or can't do it without exacting too steep a price in reduced bass, you still have two more free, if increasingly arduous, solutions.

The first is to reverse the phase of *both* speaker connections; tying the wires now on the amplifier's positive terminals to the negative and transferring the old negative wires to the positive terminals. This could set the system out of phase at the feedback frequencies. It might, however, only shift the feedback problem to a new frequency, where the system is now *in* phase . . . if it has any effect at all.

A more likely but more difficult cure is to move the speakers or the turntable. Bass, in most rooms, causes *standing waves,* alternating areas where bass is abnormally strong at certain frequencies and areas where it's weak. A turntable sitting in the peak of such a wave is a sitting duck for feedback.

To find those standing wave areas, put on a

record with a lot of bass. Turn your bass control up until you hear the bass go overwarm and mushy (a sign of incipient feedback howl). Then walk back and forth along the length and breadth of the room, listening for areas where the bass gets unexpectedly louder. If your turntable is sitting in such a zone, move it a few feet. If your turntable can't be moved, try moving the speakers.

There's one more easy cure to try before you begin spending money: remove your turntable's dust cover. Dust covers sometimes pick up sound vibrations.

inexpensive cures

Fortunately, not all the solutions which cost money necessarily cost a lot. All solutions, though, take one or more of three approaches: increasing turntable mass, changing resonant frequency, or isolating the speaker and turntable from each other.

Since the turntable shelf, rather than the turntable, may be picking up speaker vibrations, it may help to lay a slab of marble or other heavy material under the turntable. This isn't a cureall (what is?), so don't invest in a custom-cut slab of marble unless you're sure that the decorative effect alone will be worth the money to you.

You can also surround your turntable base with hardwood planks or other weighty materials, working on the turntable housing instead of the shelf supporting it. Technics sells an obsidian base to support a few of its turntables.

Isolation is the third area where you can undermine feedback problems. If the speaker doesn't shake the turntable, feedback can't occur. Short of moving the turntable to another room, you can't isolate it against airborne vibrations, but you can isolate those vibrations transmitted from speaker to turntable by your walls and floors.

Both spring and damping isolators are possible. Springs usually change the resonant frequency of the system. Each set of springs, new and original, will transmit vibrations at a certain frequency that is a function of both the spring and the weight it bears. But the set will absorb other frequencies. If you couple two systems with different resonances, the second will pass only those frequencies which the first system failed to block, so virtually no vibrations are transmitted.

Dampers absorb resonant energy, converting motion into heat. Some people find that this approach alone suffices. Speakerlab, for instance, recommends resting turntables and/or speakers on damping pads made from stick-down, foam-backed carpet material.

new turntables fight feedback

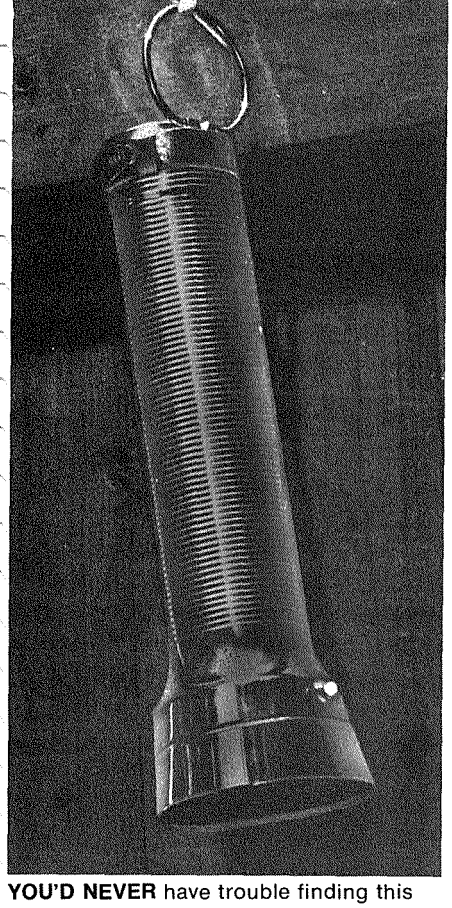
If all cures fail with the turntable you have, a new turntable may help.

- **More mass** is one way originally tried by Kenwood and now used by Optonica, Technics and others. Kenwood has several models whose bases are made of "ARCB," a compression-molded resin concrete made from limestone particles and powder, glass powder, and polyester resin. Kenwood claims this compound lowers resonant frequency by its mass and also damps vibrations under 1 kHz—the frequencies where feedback takes place.
- **Changing resonance** is B.I.C.'s approach in their newest turntables called "V.I.A." (variable isolation adjustment). The spring suspension in these models consists of four leaf springs whose compliance—hence, resonant frequency—can be adjusted by a single knob.

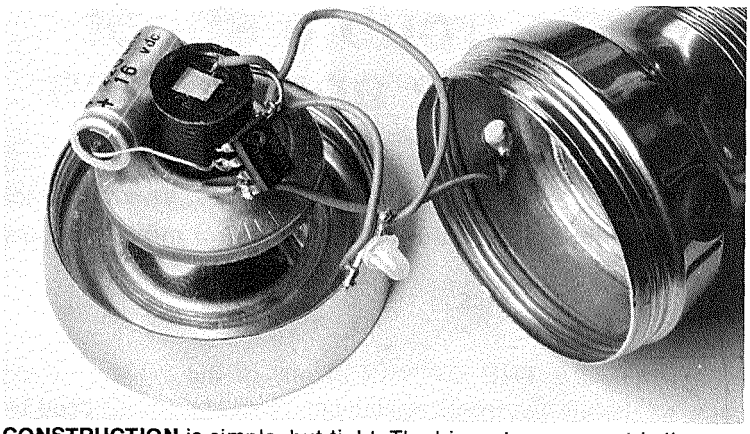
Dual's anti-resonance system concentrates on the tonearm counterweight, which contains two filters—one tuned at the factory to the resonant frequency of the chassis, the other tunable by the user to attenuate the resonance of his particular cartridge.

Isolation is a very common approach, with special attention paid to damping, springing or both in many turntable designs. The Kenwood, for example, uses highly damped rubber feet to absorb vibrations. This also lowers the "Q" or sharpness of the system resonance—important, here, because the high mass of the ARCB base raises the system Q, making it more susceptible to vibration at resonance. Additional isolating cushions are built into the arm. Further damping is designed into the turntable mat.

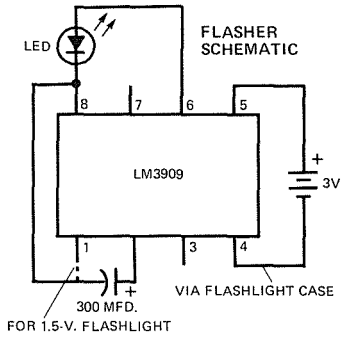
- **Floating suspensions** are used in many turntables. Here, the platter and tonearm rest on a separate subplatform suspended below the top of the turntable bass. Stromberg-Carlson used this approach years ago, Acoustic Research has been using it for about a decade, and it's used by Thorens, Pioneer, B.I.C. and many others now. The unique Oasis T-1 turntable, however, literally floats. Its two motors (wired out of phase, so their vibrations will cancel) drive an impeller at the bottom of a fluid bath. The turntable platter, with a similar impeller on its bottom side, floats in the fluid. Oasis claims this system isolates all external vibrations from the platter, as well as smoothing out minor motor-speed irregularities.



YOU'D NEVER have trouble finding this flashlight, even in the darkest room. It's easy to equip one with a blinking LED light that can save you time and aggravation in an emergency.



CONSTRUCTION is simple, but tight. The biggest component is the capacitor, so use a small one. Be sure it can handle at least 3 volts d.c.



Don't lose your temper over finding a flashlight in the dark. Let it blink the way to where it's hiding

Build a beacon into your flashlight

■ THE TROUBLE with flashlights is that you're likely to need one most when it's too dark to find it. And if you do find it, the batteries may be dead. Here's a simple circuit to solve both of these problems.

The Flashlight Finder is built around a National Semiconductor 3909 integrated circuit (Radio Shack No. 276-1705) specifically designed to flash light-emitting diodes (LEDs). The 3909, the LED and an electrolytic capacitor make up the circuit using the flashlight's own batteries to power it. The LED leads you to the flashlight—and if it should stop flashing, you know to change the batteries before it's too late. (Battery drain is well below one milliampere, which would take a year to drain most flashlight cells.)

Drill a hole in the flashlight head just large enough to be a snug fit for the LED you use, as shown above. Secure it with a drop of cryanacrolate glue (such as Krazy Glue). The circuit was wrapped around the bulb socket and grounded to the metal case, with the hot lead under the bulb-socket contact. (Plastic flashlights require a separate ground wire.) Use a 25-watt iron and don't cook the IC—perhaps use a socket.

One end of the IC is likely notched or marked with a round spot or raised mark. Pin No. 1 is at the IC's lower left when held so that the marked end points to the left. In that orientation, numbers run from left to right through pin No. 4, pin No. 5 being above it and the numbers running from right to left through the rest of the sequence.

Check the LED package to find the positive lead. If you are not sure which is which, trial and error won't hurt the LED in this circuit. You can use an ohmmeter to measure its resistance in both directions. Resistance will be lowest when the meter's red (positive) lead is on the LED's cathode. The LED's anode will go to IC pin No. 6.

You'll find the Flashlight Finder to be one useful blinker, especially since it is easy to construct.

How to trouble shoot solid-state appliances

Don't be scared off by computer-age technology. You can track down some malfunctions yourself using only a multimeter. What's needed most is an orderly approach

By MORT SCHULTZ

■ IF YOU'RE THE OWNER of one of the new solid-state electronic washing machines or clothes dryers and you know your way around a VOM (volt-ohm-milliammeter), then you shouldn't have a problem trouble-shooting its microcomputer control system.

Since it isn't possible to discuss how to troubleshoot every problem that may strike electronic control systems of washers and dryers, let's walk our way through two common failures.

washer runs, but where's water?

The only electronic component that may cause this problem is the electronic control unit. To get at the problem, open the console. With Whirlpool microcomputerized washing machines, the console is opened by removing screws at the lower front corners of the console, pulling the console forward about ½ in., lifting and then tilting the console unit forward.

The electronic control, which is a printed circuit board assembly, has two connectors attached to it—one in the upper right corner and one on the left side. The "edge" connector on the left side is the one to work with. The one on the right is the connector from a relay, which provides the on/off and high/low motor-speed functions.

Important: Before beginning the following sequence, look for more common causes of this problem. Make sure: water faucets are open; water hoses run straight (no kinks); and water-hose filter screens aren't clogged (disconnect water hoses at inlet end to check).

Now, begin procedures. Note, however, that if the electronic control tests okay, there is probably a defective water inlet valve. Steps A through K are described below and keyed to symbols for steps in Diagram A on page 167.

Steps A, B: Connect a voltmeter across terminals P and W of water-level switch B. Start washing machine A and wait eight seconds. Check voltmeter.

Step C1: If voltmeter shows 120 volts, proceed to steps D, E and F.

Step C2: If voltmeter shows 0 volts, proceed to steps G, H, I, J and K.

Step D: Replace water-level switch.

Step E: Retest.

Step F: Water should now enter washer. If not, water inlet valve is malfunctioning.

Step G: If voltmeter shows 0 volts (C2), turn off washer and pull off edge connector. Connect voltmeter between terminal BR-OR of edge connector and terminal HV of electronic control, then between terminal BR-OR of edge connector and terminal CV of electronic control. Terminal HV coincides with terminal BR-R of edge connector. Terminal CV coincides with terminal YR of edge connector. Start washer and read meter.

Steps H, I: If meter shows 0 volts (H), electronic control is okay (I). Look elsewhere to solve the problem by rechecking components above and testing for faulty wiring.

Steps J, K: If meter shows 120 volts (J), electronic control is faulty and should be replaced (K).

dryer runs, but where's heat?

Electronic components that may cause this problem are the "push-to-start" relay, which also controls heater functions, and the electronic control. The two are connected by a wiring harness which has a quick-disconnect connector that fits into the bottom of the machine's electronic control.

The console of the dryer is opened the same way as the console of the washer. Before troubleshooting, let the dryer run at high heat for five minutes to warm up the electronic components.

Steps A through K are described below and keyed to symbols in the steps in Diagram B.

Steps A, B, C, D, E: Disconnect the relay connector at the electronic control and connect a voltmeter across terminals coinciding with

CH1 and CH2 on E. Set temperature-selector switch on "heat" position A. Set cycle selector switch on the "timed" position B. Set the push-button selector of your machine's electronic control on "10" (C). Then start machine (D).

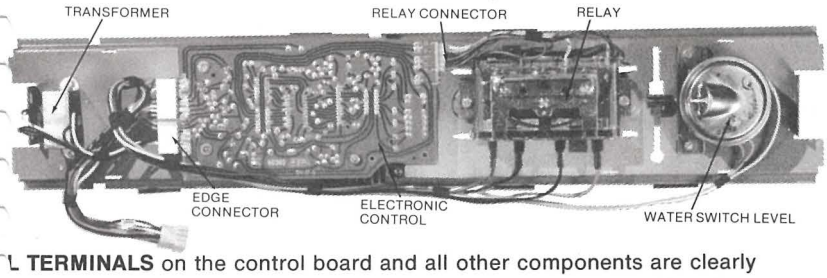
Steps F1, G: If voltmeter shows no voltage (F), electronic control is faulty. Replace G.

Step F2: If voltmeter shows 30±5 volts, turn off the power and be sure to reconnect the quick-disconnect relay connector.

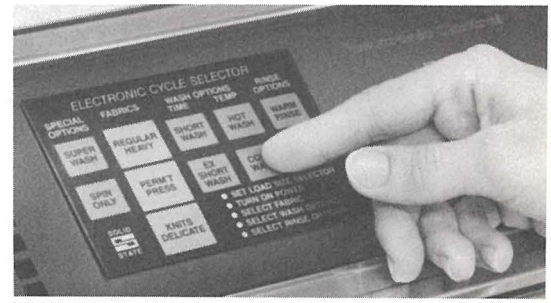
Step H: Connect voltmeter across terminals RS and RH1 of relay. Turn on power.

Steps I1, J: If voltmeter reads 240 volts (electric dryer) or 120 volts (gas dryer) (I), relay is faulty. Replace the relay (J).

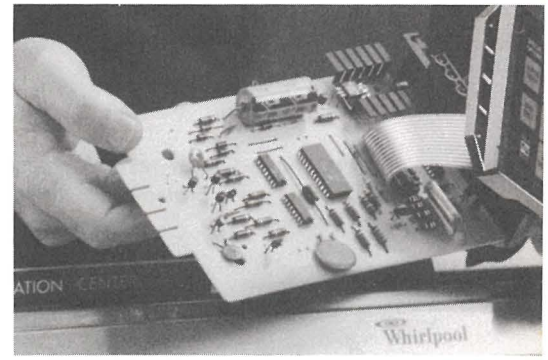
Steps I2, K: If voltmeter reads 0 volts (I2), the cause of the problem is not with an electronic component, but with the heating element, gas burner, fuse, thermostat, wiring, centrifugal safety switch or motor. Locate the problem and make the needed repairs (K).



L TERMINALS on the control board and all other components are clearly distinguishable, as shown above. You should have no problem making the correct nnections.

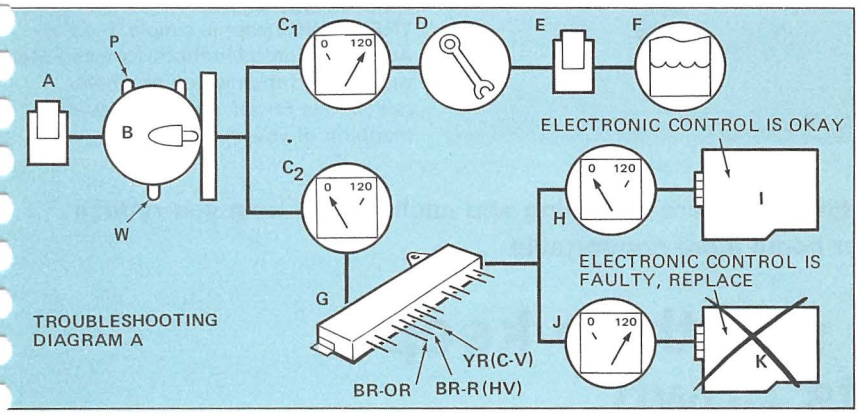


NEW microcomputerized clothes dryer doesn't have a timer. Buttons are pressed to select length of drying period and temperature, and to start the unit.

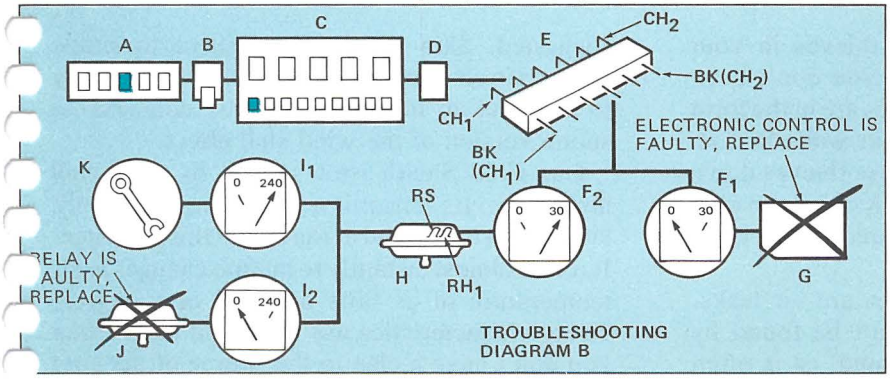


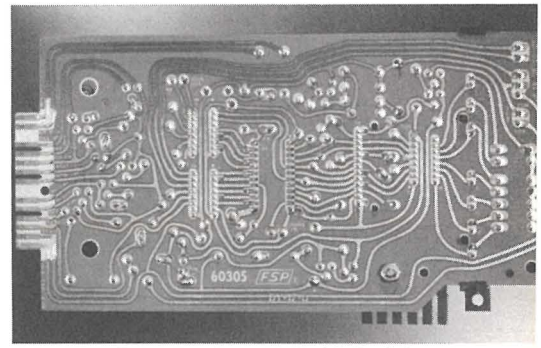
THE ELECTRONIC control board (above) is beneath the touch control panel of a solid-state washer. Touch signals are transmitted to control board, which uses integrated circuits to control wash cycles.

OUBLESHOOTING sequence below is used if washer runs, but water doesn't fill.

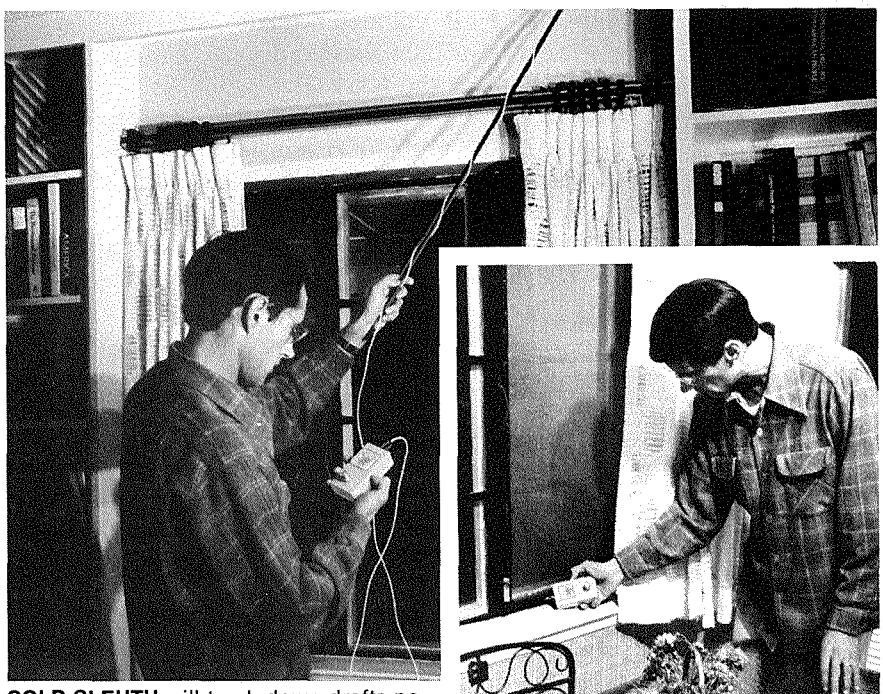


AGRAM below shows troubleshooting sequence if dryer runs, but there is no heat.

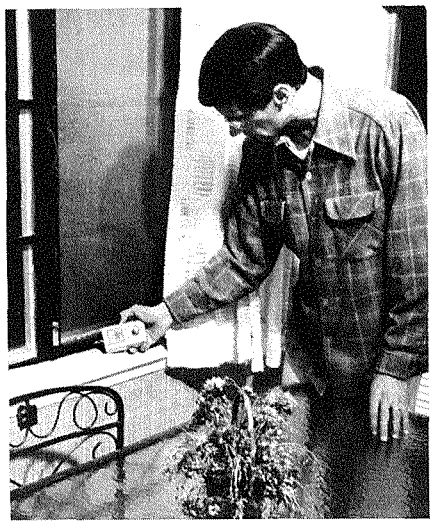


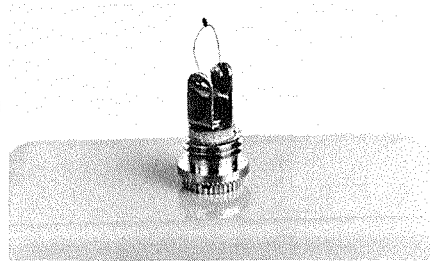


THE PRINTED circuit or "foil side" of the electronic control board is the side at which all troubleshooting sequences are carried out using a multimeter.

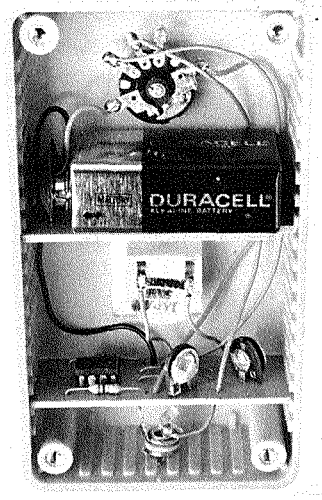


COLD SLEUTH will track down drafts no matter where they hide. Hold it in your hand for the easy-to-get-to spots. Use the optional probe and cable for any higher places.





THE TINY thermistor (right) is fragile. You should remove the protective cover only when in use.



THE WIRING (top) is simple and easy. Adjust the control (bottom) for a mid-scal reading and then watch the meter deflections for an accurate thermal mapping of your home.

By JEFFREY SANDLER

Use this handy gadget to find out where insulating and caulking will help you reduce those costly fuel bills and make your home more comfortable

Build a cold sleuth to keep heating costs down

■ YOU HAVE cold-blooded thieves in your home, robbing you blind, and you don't even know where they are. The thieves are in the form of cold areas and cracks in your walls that let valuable heat escape. Track these thieves down with our electronic Cold Sleuth, lock 'em up with some insulation and caulking and you'll bank part of your fuel bill.

Often, the worst heat thieves are air leaks. Unfortunately, many leaks can't be found by simply waving your hands around, as is often suggested. Skin isn't that sensitive to subtle changes in air temperature; worse, it is very easy to interpret air movement as false coldness—a subtle version of the wind chill effect.

Our Cold Sleuth isn't subject to wind chill limitations. Its sensor is a tiny thermistor hardly larger than the period at the end of this sentence. It reacts almost instantly to minute changes in air temperature of as little as 1/100 of a degree. These characteristics are what you need when you don't have a clue to the source of the cool

air. Since the thermistor is at the same temperature as the surrounding air, wind chill has absolutely no effect.

A thermistor exhibits large changes in its electrical resistance for small changes in its temperature. Cold Sleuth's circuit monitors the thermistor's resistance with a balanced bridge circuit. Any imbalance in the bridge caused by temperature variations is amplified by the LM 358 IC and displayed on the meter. The net result is that the meter moves to the right when the thermistor gets warmer, and to the left when it becomes colder.

The best time to look for heat leaks is on a cold, windy day, when the smallest leak is obvious.

Here is how to use the cold sleuth: Center the meter needle in the scale with the potentiometer mounted on the case. As you probe around, the needle will move upscale or downscale, depending on the temperature changes. If you were to do a very thorough mapping, you would keep track, on a piece of paper, of the variations over all the surfaces of the house. A more casual approach would be a search for big drops in temperature and large leaks only. Either method will save heat dollars.

The Cold Sleuth is sensitive, so make sure you stay behind the unit. Otherwise, the slightly warmer air that trails your body will pin the meter to the hot side.

Now for the places that you can't reach. We have designed Cold Sleuth to use about 10 feet of cable. The thermistor can be dropped down vents and ductwork, or between walls to look for hidden cracks and leaks. Tape the thermistor holder and cable to a long pole, and, unless yours is an unusual house, you can check your ceilings and vents without a ladder.

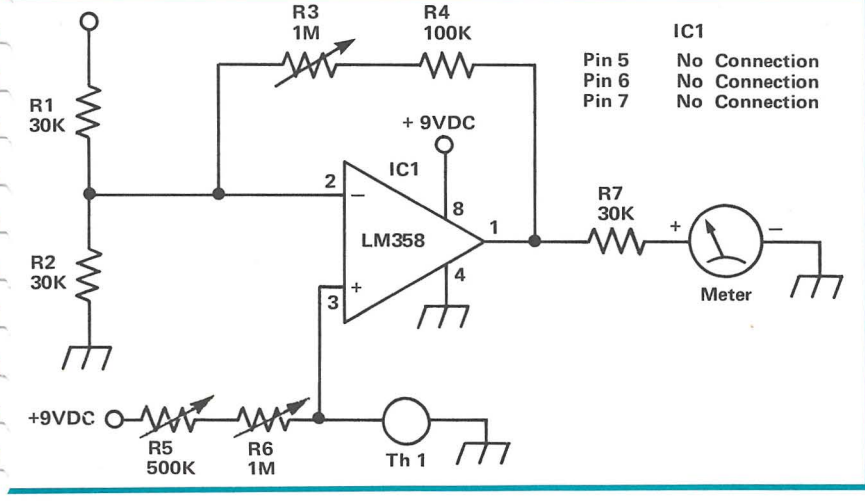
If you have an airconditioner, don't pack away your Cold Sleuth in the summer. If your house is poorly insulated or has leaks, the airconditioner has to work much harder. Use Cold Sleuth in reverse, and look for the hot areas. With electrical costs already high and going higher, you could save a bundle.

construction kit available

Construction of the ColdSleuth is easy and can be done in a single evening. There are only seven parts to be soldered onto a predrilled, labeled printed circuit board. All these items are available in a construction kit (see parts list). Wires from the circuit board go to the meter, the centering potentiometer, and the jack for the thermistor plug with its protective cap. Holes are cut in the ABS plastic case for the meter, jack and potentiometer. The battery and the printed circuit board slide into slots inside the case.

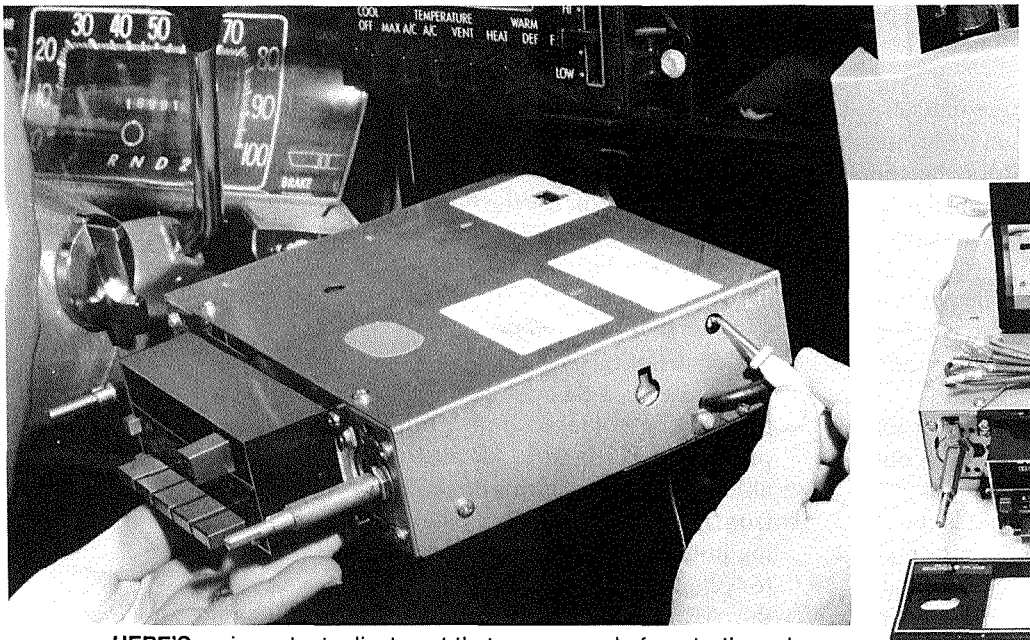
The coarse trimpot on the circuit board is easy to adjust; just set it so the needle is in the center of the scale. The purpose of the other trimpot is to adjust circuit gain.

At the highest gain, the Cold Sleuth can resolve down to 1/100° and this makes for wide swings of the meter in most situations. Even in still air, the needle moves back and forth due to minute differences in the temperature of air eddies. Only by covering the thermistor can you stop the needle motion. To facilitate reading, the gain control lets you cut down the sensitivity to a level appropriate to what you are working on. Generally, set the gain trimpot so you get deflections of the needle without going off scale.

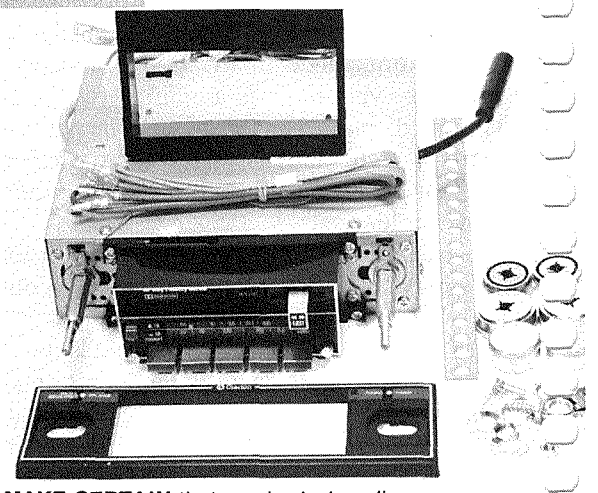


PARTS LIST—COLD SLEUTH

IC1—LM 358 Integrated circuit
R1, R2, R7—30,000-ohm resistor, ¼ watt
R3, R6—1-Megohm trimpot resistor
R4—100,000-ohm resistor, ¼ watt
R5—500,000-ohm potentiometer
TH1—81B804 bead thermistor (Available from Midwest Components Inc., Box 787, 1981 Port City Blvd., Muskegon, Mich. 49443.)
Meter—100 uA
Misc.—Hammond No. 1591 ABS plastic case; two pair matching plugs and jacks (minisize); shielded cable; battery clip; knob.
Note—A complete kit, including all components, is available for $19.95 postpaid from Circuit Craft Inc., 10 Idell Rd., Valley Stream, N.Y. 11580



HERE'S an important adjustment that many people forget—the antenna trim. Adjust for the loudest volume at the high end of the AM band.



MAKE CERTAIN that any in-dash radio you install comes with all the mounting hardware and a mounting bracket. The unit shown is Clarion's PE751-A. Everything needed for installation is included in the kit.

Car stereo—install it like a pro

By HERB FRIEDMAN

If installation worries have kept you from getting the new great-sounding stereos, let us show you how easy it is. Those kits mean supersound can be only hours away. Special adapters and mounting hardware make installation simple in most cars

■ THERE'S A NEW SOUND on the highway that's being called "autosound." Whatever you call it, it all comes down to the fact that just about anyone can upgrade the typical car radio or radio/tape player to a stereo high-fidelity system on wheels.

Fact is, the equipment is available as direct-replacement hardware—meaning it's made to be directly substituted for what you already have installed in your car, van, or RV. With rare exception, the upgrading to highway hi-fi won't involve much more wiring than snaking two pairs of wires under the carpeting to the trunk for a set of stereo rear-deck speakers.

Loudspeakers make the most significant improvement; simply replace the existing speakers with autosound models, and it's as if a whole new world of sound were created in the car.

An autosound speaker delivers the best possible sound for its size—not necessarily true high-fidelity sound. For example, mid-size Chrysler and GM cars use 3½-inch stereo speakers up front in the dash. There is no way anyone will get real bass out of a 3½-inch speaker. There are few minispeakers that can handle the power needed for loud sound without generating severe distortion. One of the very best, according to many experts, is the Jensen 3½, whose magnet is almost as big as the speaker itself.

What if your dash isn't cut for 3½s? It has only a mono 4 x 10-inch speaker? No sweat! On the GM you replace the 4x10 speaker with an adapter bracket that supports two angled 3½s. It's not the greatest separation in the world, but it's stereo. On Chryslers you'll find the 4 x 10 approximately in the center, and a 3½-inch "well" under the dash cover on each end. You can use a 4 x 10 adapter bracket, or mount the 3½s in the

end wells. Punch the dash cover for a 3½-inch opening and cover with a perforated trim plate available from some (not many) autosound dealers.

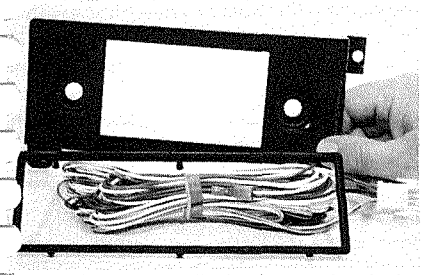
Even if you can use larger speakers in the dash, the really solid bass and maximum volume come from speakers mounted on the rear deck. These are the "hi-fi" speakers, usually 6x9-inch woofers with a tweeter or with a honker for the midrange and a tweeter for the upper high frequencies.

If your car already has rear-mounted speakers, simply remove them and substitute hi-fi autosound speakers. These should have the *same* mounting-screw locations. Remember, size is not as important as mounting-screw location because you want to be able simply to exchange speakers without the need to drill new holes in hard steel.

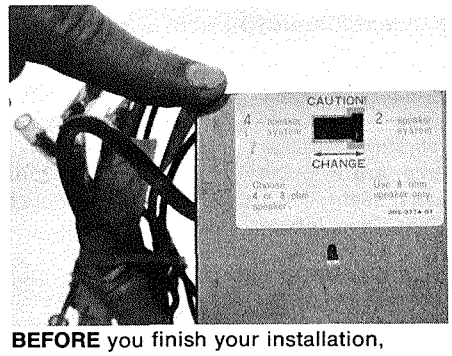
You need to match mounting holes because many hi-fi autosound speakers are considerably larger than the speakers they replace, yet everything is designed to fit standard speaker openings, usually 6x9 or 4x10 inches (6x9 is almost a universal rear-deck standard). The whole mounting problem is tied into the fabrication of the rear deck: The speaker will distort when the mounting nuts are torqued, but wide tolerances in budget speakers handle the warp with no effect on their somewhat limited sound quality. High-fidelity speakers, however, are precision devices, and a warped frame will lead to rubbing of the voice coil, which produces an irritating buzzing or distortion.

On the other hand, Clarion and others have surface-mounting speakers: 6x9 woofer and side-mounted honker and tweeter in an oversize rigid housing that drops directly into a 6x9 opening from the top of the deck. The surface-mounting speaker is oversize, but it uses standard 6x9 mounting holes. (It is mounted on top of the rear deck in cars which have a full rear-deck speaker cutout, not slots.)

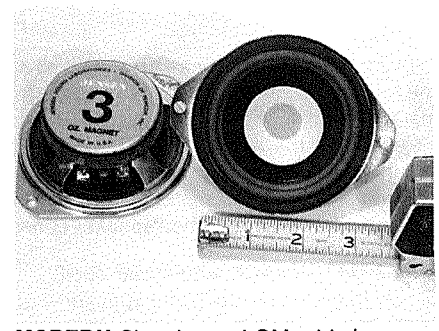
If your car isn't wired with rear speakers, look at the rear deck from inside the trunk. On a reasonably late model, say 1970 or later, there will probably be two 6x9 or 4x10 cutouts in the metal underdeck. Follow the cutout with a keyhole saw to cut through the cardboard or thin veneer rear-deck cover in order to create open-



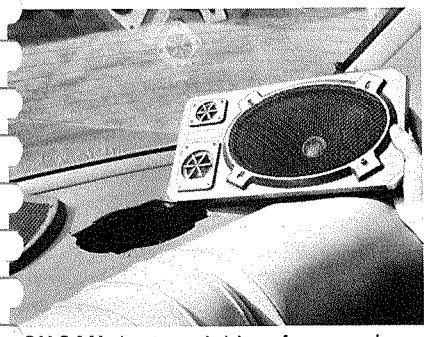
IF THERE is no radio in the car to start with, you'll need a metal mounting bracket or adapter, such as this one. Some makers offer special kits.



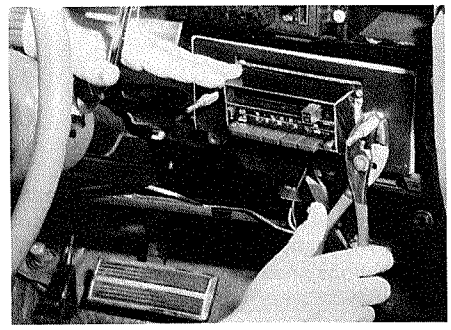
BEFORE you finish your installation, check that the speaker selector switch on the radio is set to the right number of speakers for your configuration.



MODERN Chrysler and GM mid-size cars can only accommodate small speakers. Get a speaker like these Jensen 3½s with large magnets to deliver bass notes.



YOU CAN also try a rigid-surface speaker like this Clarion SK-103. Though it has one tweeter and honker next to the woofer, it fits a 6x9-inch cutout.



MAKE SURE the radio works before finally securing it into the dash. Then tighten the nuts on the two shafts that secure the radio to the mounting plate.

ONCE RADIO is in, check out each function —even those you won't use very often. The completed installation should look just like a factory job—only better!

ings for rear-deck speakers. If your car has only one rear cutout in the metal underdeck, or none, simply use a speaker supplied in a "wedge" enclosure made to mount on top of the deck.

In autosound equipment you have your choice of AM/FM stereo, AM/FM stereo with stereo cassette (usually with automatic reverse at the end of one side), or AM/FM stereo with an 8-track stereo tape player, though 8-track is fast fading in popularity in favor of the cassette (because you can record cassettes at home and play them in the car). There are high-end models with Dolby FM, Dolby tape decoders, separate bass and treble controls and—well—just about any feature you would find on home high-fidelity equipment.

But take warning. The unit you want may not fit your dash. Volares and Aspens are very tight front to rear. About six inches is all you have, but it's usually enough for a radio/tape player whose leads come out the side or bottom (not the back), such as the Clarion PE-751A. A Buick Century has a shade extra room and can handle a Jensen R420 whose leads come out the rear. The new X-body GM cars can, so far, take nothing but the radio GM plans to supply as standard equipment (you tape fans will be stuck with an easily stolen under-dash mounting for a tape player).

Almost all new and late-model cars have radios that are installed from the front, generally in a plastic "honeycomb" (a compartment for each item). If you already have a radio, it is secured to a metal mounting plate; use this plate for installation of your new radio. If your car has no radio, obtain a mounting plate or adapter; you cannot install the radio with the so-called "universal mounting hardware" supplied. This hardware is *universal* only if the radio installs from behind the dashboard or if you have the mounting plate.

All reliable manufacturers such as Clarion and Jensen have installation kits for specific cars which include the mounting plate, any special wiring cables and speaker grilles. But not every dealer sells the kits, or even admits they exist. If you need a mounting kit or plate, and your dealer says there's no such thing, look for another dealer or phone the distributor for the company whose radio you want to buy. If he gives you a hard time, better select a different radio. *You cannot install a front-mounting radio without a mounting plate or kit.*

How to install autosound in a hatchback

Many compact American cars, as well as foreign cars such as the Rabbit we used, are hatchbacks. A hatchback can often make installation a nightmare. You usually cannot use flush-mount speakers, as the rear shelf is often merely decorative. Surface-mount speakers are possible, but they can interfere with the operation of the hatchback, particularly if the rear seat folds.

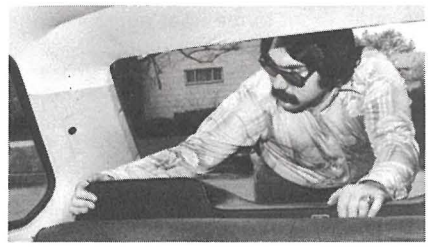
We used a newly designed speaker console from Clover Industries; they have consoles available for most any hatchback with a rear shelf, both foreign and American. Once installed, the console produced good sound and allowed normal operation of the hatchback.

The radio we chose came with all mounting hardware. When you buy, be *certain* the manufacturer gives *everything* you need.

FOR A HATCHBACK with a rear shelf, Clover Industries likely has a speaker console to fit. Installing speakers in such cars once was hard—but not anymore.

NOTE the clips on the side of this Clarion PE-662C unit—you need them for Rabbits and Audis. Clarion radios have mounting kits for most imported cars.

THE SPEAKER console from Clover matches most upholsteries and, from outside the car, doesn't announce your expensive autosound system in the dash.



AGAIN, don't forget AM trim adjustment. Doing it now will assure you of good sound later. The trimmer may be hard to find, but instructions should show it.

CONNECTING ground wire is usually done with a small clip. At the other end you can go to your cigarette lighter or to the fuse panel. Get the polarities right!

ONCE AGAIN, the final installation. Note how mounting plate Clarion supplied fits dash perfectly. It's little touches like this that make for good styling.

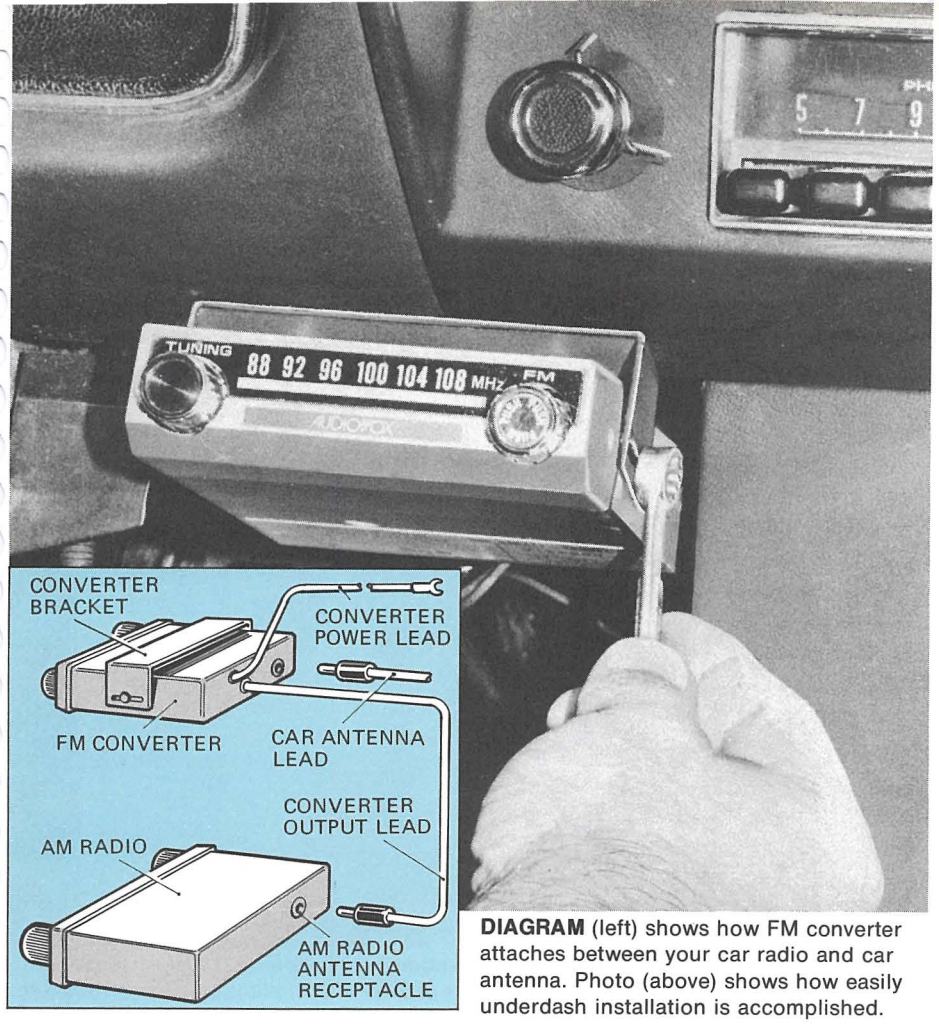


DIAGRAM (left) shows how FM converter attaches between your car radio and car antenna. Photo (above) shows how easily underdash installation is accomplished.

One of the cheapest and simplest ways to add FM to an AM car radio is a converter. You install it yourself. It should take less than an hour! Here's what you need to know

Install an FM converter in your car

By J. RAYMOND TRULL

■ WANT MORE VARIETY in your traveling entertainment? Add an FM converter to your car's AM receiver! It's a quick task barely more complicated than locating your car's fuse box and using a screwdriver.

The converter becomes an electronic link between your car's antenna and AM radio. All FM signals are modified to an AM frequency—usually 1400 kHz—and fed to the AM radio via its antenna connector. When the converter is "off," the original antenna signal enters the radio for normal AM reception.

Putting the Audiovox FMC-IC converter to work in a Pinto—a quick four-step sequence—typifies procedures for most converters.

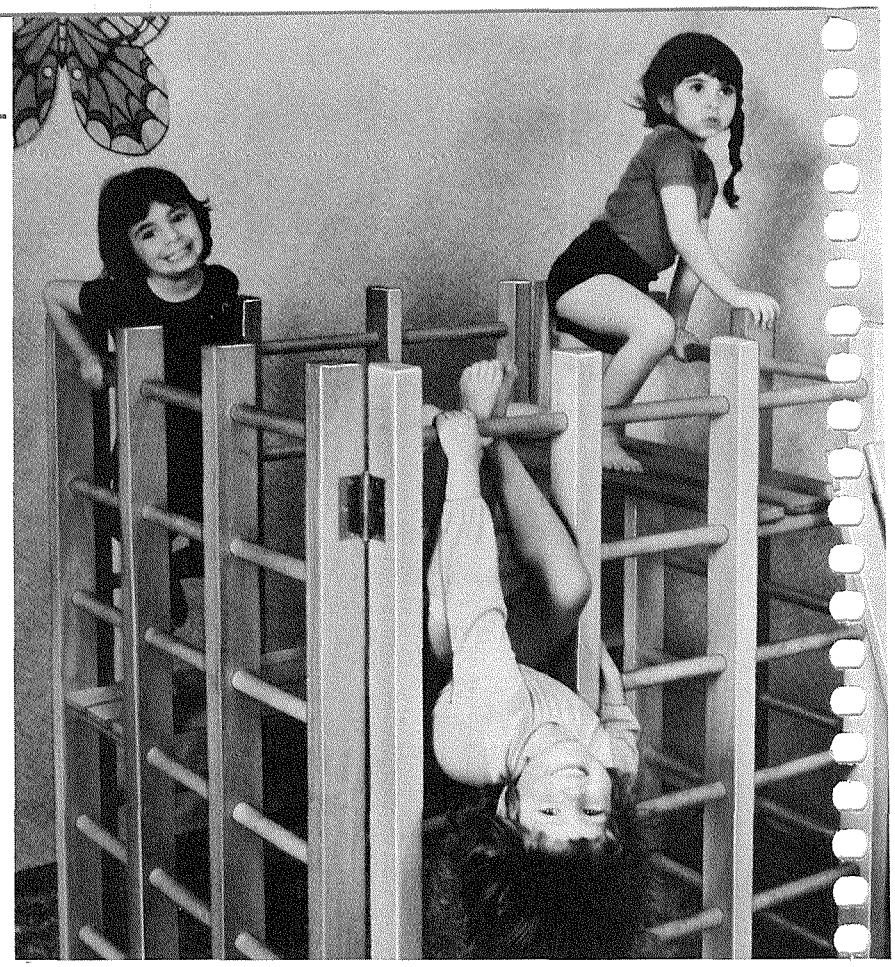
- Mount the converter with self-tapping screws. (The lower skirt of the dash is a convenient location.)
- Switch the antenna lead from the radio to the converter and attach converter output leads to the AM antenna receptacle.
- Connect the converter power lead to the fuse box accessory post or to another source of battery power. I tapped a lead intended for a clock or cigaret lighter that was not included in my economy-line car. The converter's own one-amp. fuse gives built-in overload protection.
- Tune the radio to 1400 and select an FM station on converter's dial.

The only problem you may have is that a strong AM station right on 1400 would require that the converter be tuned to a different frequency. Doing so necessitates changing the AM radio to a slightly lower unused frequency and turning the converter's exposed tuning slug until the FM reception is best. Assigning one of the AM radio's pushbuttons for the converter frequency speeds switching to FM. The converter-fed radio produces good-quality sound and is largely free of static and hum.

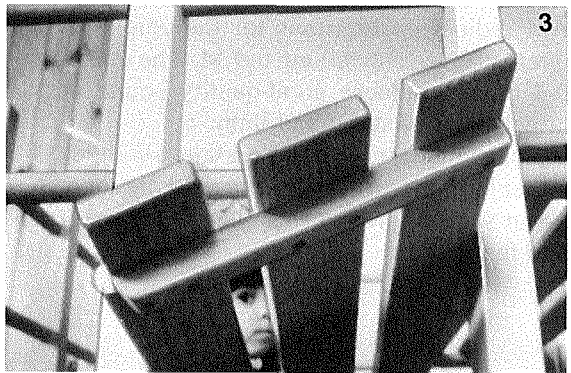
The converter we installed sells for about $14. Other brands currently on the market range from about $11 to more than $35 depending on quality and features.

Ladder-climber becomes almost anything

By PAUL LEVINE



THIS DURABLE climber can be built entirely with handtools. 1. Design inspires all sorts of activities—including game of peekaboo with photographer. 2. Kid's-eye view of climber from above. 3. Platforms are removable for more play options.



WE CALL IT a ladder climber, and it's reminiscent of the monkey bars found in so many playgrounds. But let your kids—and their imaginations—loose and it becomes a desk, a jail, a fort, a space capsule, a computer console or . . . you name it. The unit's movable platforms facilitate the transformations.

To build the climber, all you need are some basic tools and the materials listed. Bonus: If you're short of space, it folds flat.

Begin work by cutting uprights (A). Round edges with a block plane or router and ¼-in. rounding-over bit. Then sand them smooth.

Choose eight uprights for corner pieces and mark them for future identification. Position hinges on the uprights and trace their outlines. Remove the hinges and use a chisel to make the mortises.

Make centered marks on the uprights where the rungs (C) will attach. Remember to leave a blank space for the doorway. Bore holes for the rungs with a brace and bit or use a drill and power bits. Cut the rungs to length.

Assemble the sides using pipe clamps or rope for sufficient pressure to clamp the dowels. Now

you can hinge the sides together.

Saddle (B) at the base of the doorway adds strength to the unit. Cut it and chamfer its top edges. Note notches in leg bottoms to receive the saddle. Fasten saddle in place with glue and screws.

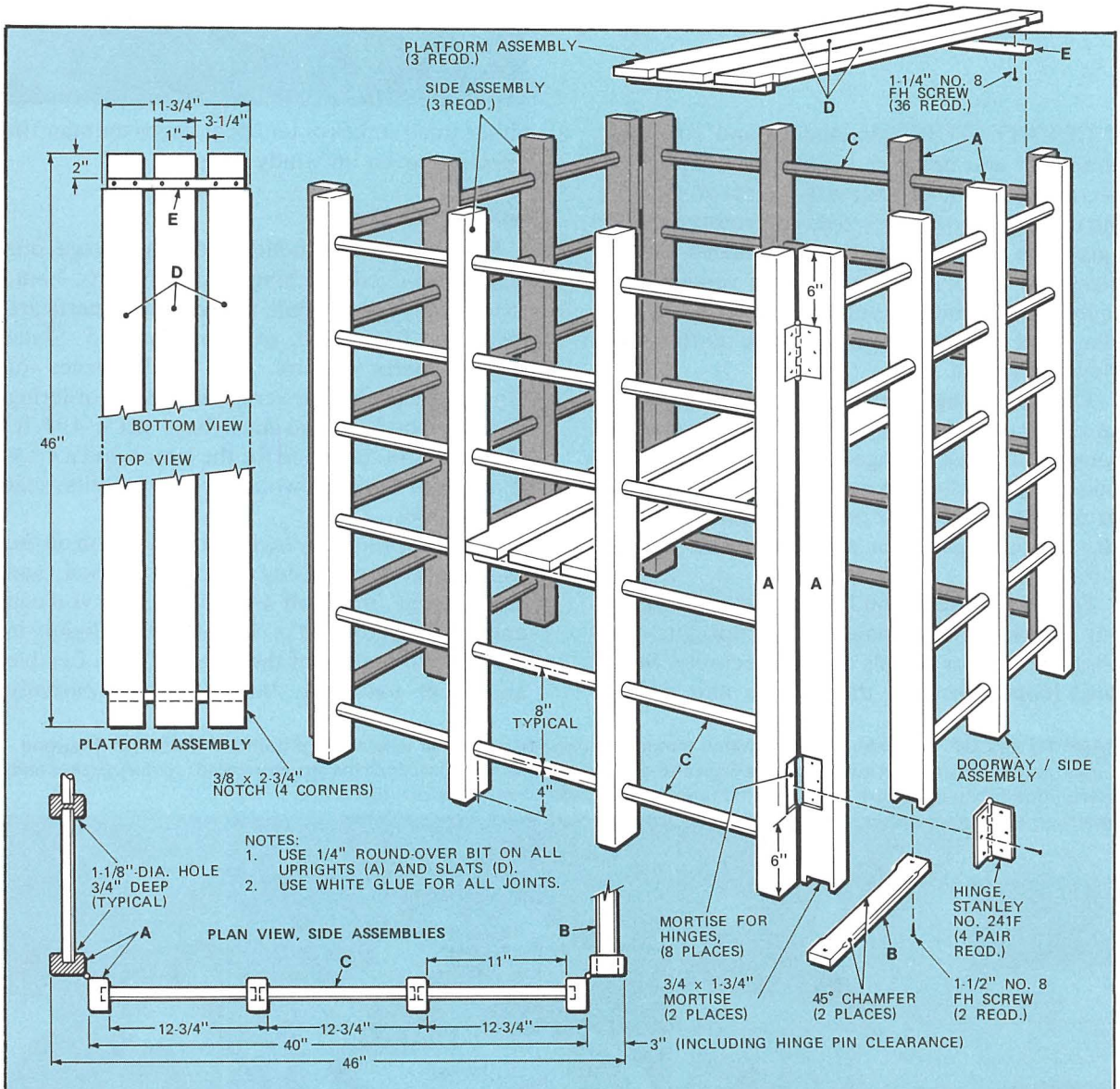
The three platforms fit into any opening in the climber. In the lower positions they serve as benches or steps. In the middle positions they're used as counters, desks or walkways. Placed on top of the climber, the platforms can serve as the roof.

Cut slats (D) to size and carefully round and sand all edges smooth to eliminate splinters. Three slats fasten together with two cleats (E) to make a platform.

Cut and sand the cleats. Mark and bore screw pilot holes, countersink and attach cleats with screws.

After assembling the platforms, notch them at corners to fit snugly in place. You will need to cut away the excess in several steps and test-fit between cuts.

Once the kids get the hang of moving the platforms, you'll be amazed at the transformations this climber will undergo.



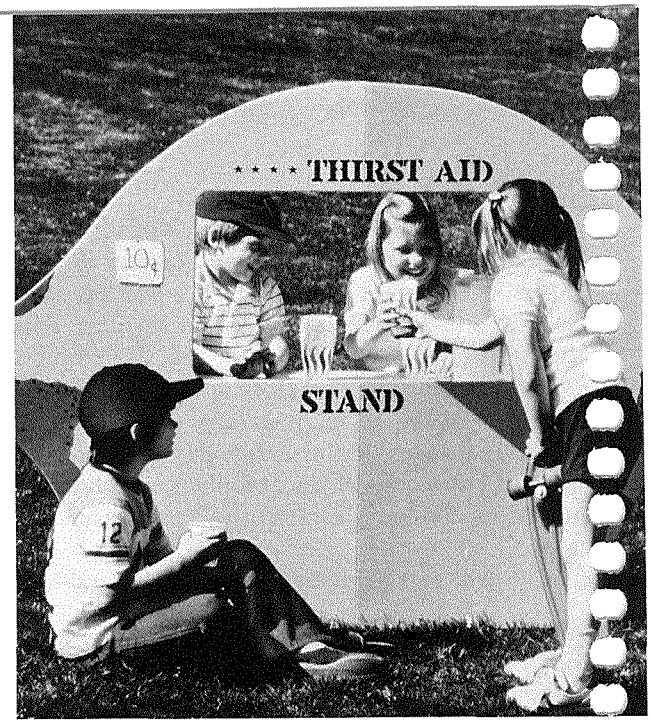
MATERIALS LIST—LADDER CLIMBER

Key	Pcs.	Size and description (use)
A	16	1¾ × 2¾ × 48" poplar (uprights)
B	1	¾ × 1¾ × 14" red oak (saddle)
C	68	1⅛"-dia. × 12½" hardwood dowels (rungs)
D	9	¾ × 3¼ × 46" red oak (slats)
E	6	¾ × ¾ × 11" red oak (cleats)

Misc.: 4 pr. 241F brass-plated Stanley hinges, white glue, 2 No. 8 × 1½" fh brass screws, 36 No. 8 × 1¼" fh brass screws. *Note:* Standard 2×3 can be substituted for pieces A.

Build the best lemonade stand on your block

By ROSARIO CAPOTOSTO and HARRY WICKS



■ CREATE THIS lemonade stand for your youngster and he or she will have a leg up on becoming the most successful entrepreneur in the neighborhood. We sized our prototype to fit kids from ages 6 to 8, but dimensions can be increased slightly if you want your version for a slightly older child. If you do, make certain you plan your layout carefully before cutting the plywood pieces.

The stand is lightweight, quite strong, easy to knock down and set up, and folds into a compact package for easy garage storage. To make it a snap for youngsters to maneuver the stand from storage to business site and back again, we have also included plans for an easily made hauling "crate."

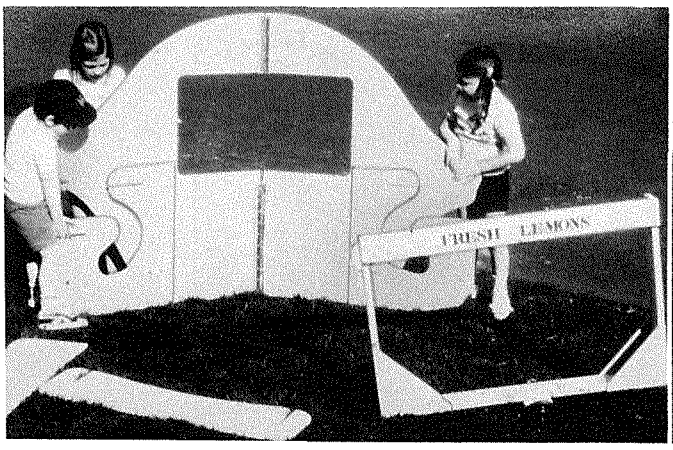
To prevent the lemon from being blown over, our design includes holes in the uprights (see photo below) for lashing the unit securely. Stout cord looped through these holes and tied to either small stakes or tent pegs keeps the stand in business, even on windy days.

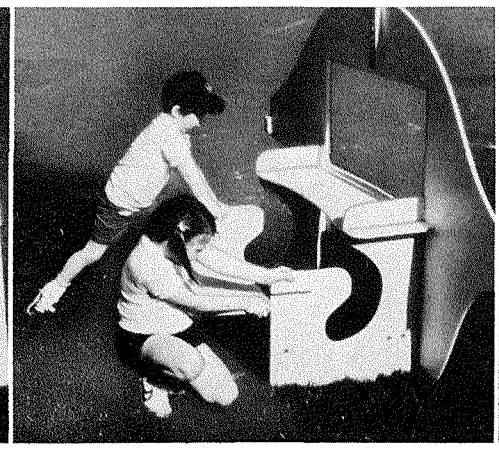
building the stand

For convenient handling and easy storage, our lemon is halved and hinged. It's made of ⅜-in. exterior plywood, while the remaining parts are fashioned from ½-in. exterior plywood. Since several parts require just small pieces of plywood, check your scrap pile before ordering new plywood. If you must buy, get a 4×6-ft. sheet of ⅜-in. plywood for the lemon and a 4×4-ft. sheet of ½-in. plywood for the uprights, seat and counter.

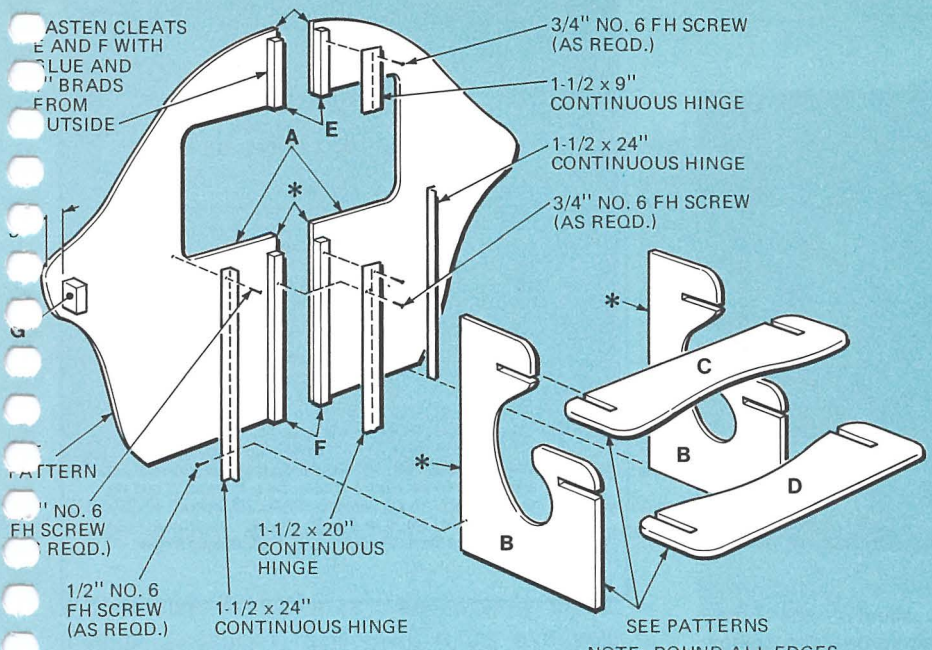
Start the project by laying out the lemon on the ⅜-in. plywood. Using a ruler, pencil and straightedge, mark off 4-in. squares so you can enlarge the pattern. Tip: Draw the lines lightly in the general outline of the lemon. Use a flexible aluminum yardstick, braced against partially

EASY TO SET UP, this colorful slip-together lemonade stand becomes an instant neighborhood attraction. Plywood wings (below, left) fold out into a U shape. Seat and shelf then slide into slots to lock the structure rigid (center). Stakes and safety rope brace the entire stand against unexpected gusts of wind (below, right).





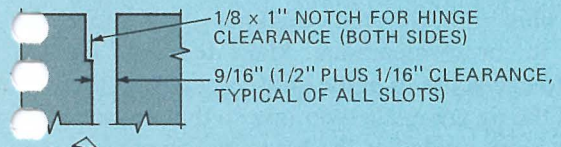
LEMONADE STAND, EXPLODED VIEW



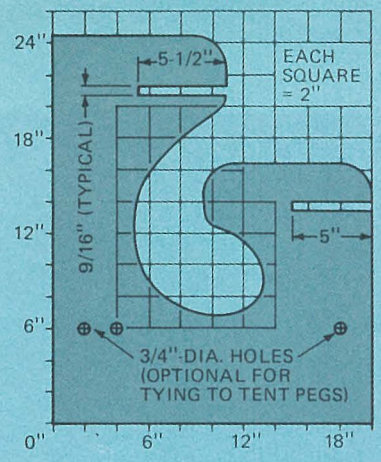
SEE PATTERNS

NOTE: ROUND ALL EDGES WITH 1/4" ROUNDING-OVER BIT IN ROUTER. DO NOT ROUND EDGES MARKED WITH AN *

FOR PLYWOOD CUTTING PATTERN INSTRUCTIONS SEE TEXT



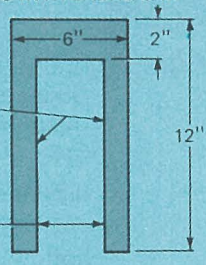
PATTERN FOR SIDES, B

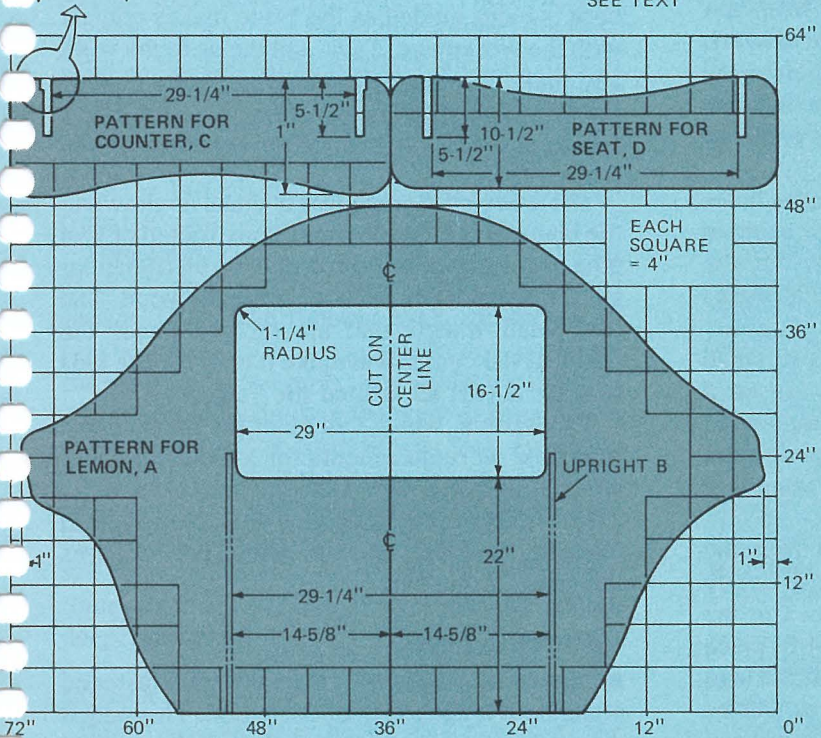


JIG FOR CUTTING SLOTS WITH SABRE SAW

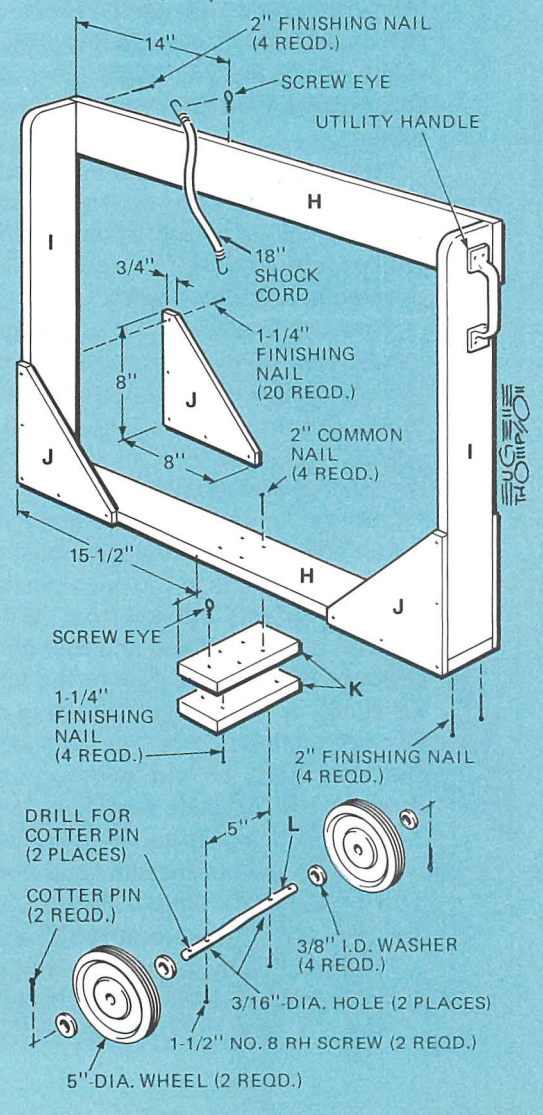
TO USE: TACK-NAIL IN PLACE. MAKE 2 CUTS, GUIDING SAW SHOE AGAINST EACH SIDE OF OPENING

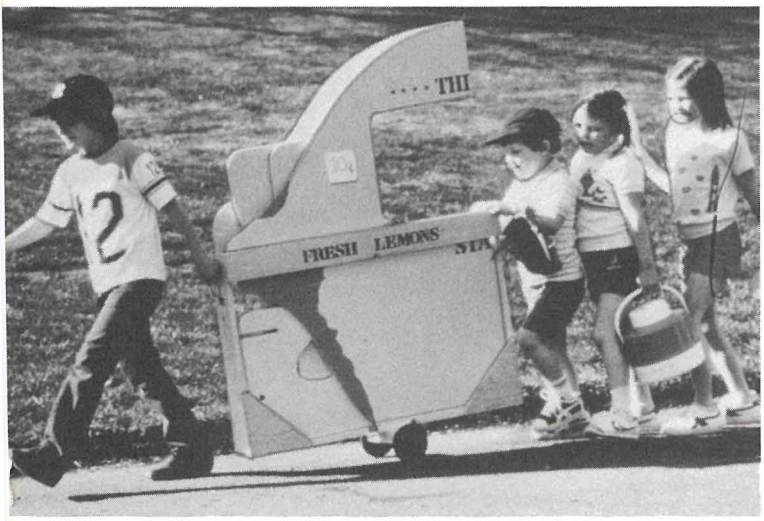
INSIDE JIG WIDTH IS EQUAL TO WIDTH OF SAW SHOE MINUS THICKNESS OF SAW BLADE, PLUS 9/16" (SEE TEXT)





CART, EXPLODED VIEW





WHEN IT'S TIME to close up shop, stand is folded neatly in half and toted in the rugged but lightweight "lemon crate." Unit takes little storage space.

driven nails, to draw the final, smooth, sweeping curves. Then draw the centerline. If you use a hollow-ground plywood blade in your sabre saw, you can do the drawing and cutting from the front (rather than having to reverse the artwork and draw on the back). On this project, the very slight splintering you might get will be acceptable because you later round over the exposed edges.

Lay out the window and bore four large holes exactly on the four corners. Then, using a straightedge to insure accurate lines, cut the window out with your sabre saw. Sand all edges to remove any saw ripples.

To prevent any chance of splinters in small hands, ease all exposed edges slightly. Insert a ¼-in. rounding-over bit in the router and adjust bit depth for a ⅛-in. cut. (This will leave a flat against which the bit's pilot can ride when you rout the second side.)

Cut the lemon in half, but do not rout the center edges because the joint must close tightly when the lemon is in the open position. Cut the counter, uprights and seat from the 4×4-ft. piece of ½-in. plywood. Sand and rout all but the lead edges of the uprights (where the hinges will be fastened). A 3/16-in.-deep rounding-over cut can be made on these parts. The slots for the counter and seat must be cut with accuracy. These should be just a shade over ½ in. wide to allow clearance for easy fitting when pieces are joined.

Carefully lay out the slots and make the cuts. You can make a simple jig (as shown in the drawing) to cut the slots out with your sabre saw.

To determine the jig's slot width, measure the distance from each side of the blade to the edge

MATERIALS LIST—LEMONADE STAND

Key	Pieces	Size and description
A	1	⅜ × 48 × 72" exterior plywood
B	2	½ × 20 × 24½" exterior plywood
C	1	½ × 11 × 36" exterior plywood
D	1	½ × 10½ × 36" exterior plywood
E	2	¾ × 1 × 9¼" pine
F	2	¾ × 1 × 20" pine
G	1	1½ × 1¾ × 2½" pine
H	2	¾ × 3½ × 37½" pine
I	2	¾ × 3½ × 24" pine
J	4	⅜ × 8 × 8" exterior plywood (use scrap from A)
K	2	¾ × 3½ × 6¾" pine
L	1	⅜" dia. × 9¾" steel rod
M	1	¼ × 6 × 12" exterior plywood

Misc.: Utility handle, 18" shock cord, 2 screw eyes, 4 ⅜" i.d. washers, 2 5"-dia. wheels, 2 cotter pins, 1" brads, 2" and 1¼" finishing nails, 2" common nails, ⅜" No. 6 fh screws, ¾" No. 6 fh screws, ½" No. 6 fh screws, 1½×20" continuous hinge, 1½×9" continuous hinge, 2 1½×24" continuous hinges.

of the saw shoe (they differ). Add both dimensions, plus ½ in. for stock thickness, and allow 1/16th in. or so clearance. Make test cuts on scrap to check the fit of the joint. Notice that the legs of the jig are made overlong so that the saw base is being guided as the blade makes contact with the workpiece. Tack-nail the jig to the work and make two parallel cuts, alternately guiding the saw against each edge of the jig's slot. Use a coping saw to make the bottom cut and drop out the waste.

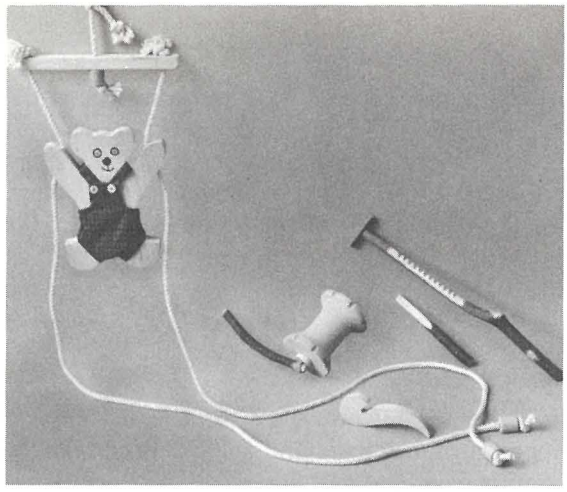
The wheeled storage cart is made as shown in the plans. It is a simple frame constructed of 1×4 pine braced at the bottom corners with triangular gusset plates made of ⅜-in. scrap plywood. The two small wheels that are located under the frame at the center will make it easy for the kids to roll the cart all around the yard.

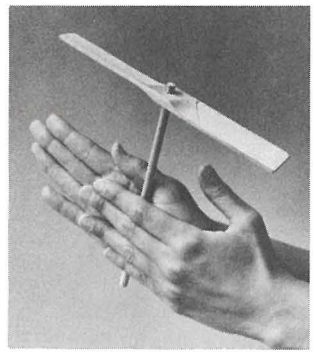
The wheels, which can be of the inexpensive type sold as replacements for a child's wagon, are mounted on a ⅜-in. steel rod that serves as an axle. Washers and cotter pins hold the wheels in place on the axle. An 18-in. shock cord secures the stand in the cart.

construction hints

- Notice that standoff cleats are glue-fastened along both hinge edges of the lemon. This added dimension permits the two halves to lie parallel when they are folded.
- Make certain you bore holes for lashing the lemon upright. Play it safe and insist that your youngster use cord and tent pegs. If you were not to have a tie-down system, a strong breeze could bowl over your stand.
- Before painting, prime all plywood surfaces with pigmented shellac, such as BIN or Enamelac. **Do not** prime inside edges of the slots.

Build these toys from the past





THE FIVE CLASSIC American folk toys shown here are from left: climbing bear, spool tractor, skyhook, whimmydiddle stick, and the flying machine (inset).

By DICK SCHNACKE

BEFORE TOYS were commercially made, families fashioned their own, using available materials—wood, scraps of cloth, corncobs and string. Here are five "classics."

whimmydiddle, hooey stick or gee-haw

This stick works like magic. When you rub another stick across the notched stick, the little rotor at the end turns. Rub the notched stick in the opposite direction and the rotor turns the other way. These "gee" and "haw" movements created a legend that the whimmydiddle was a lie detector, but it is the operator who actually controls the "true" and "false" answers.

Directions: Use a small hardwood branch that does not have a pithy center. Cut the sticks as shown. Carve the rubbing stick, cut six to 10 notches about ⅛ in. deep and evenly spaced on the top edge of the body, and shape the rotor so its ends have the bulk of the weight. Bore a hole in the center of the rotor for the nail. Drive the nail into the end of the body, leaving the rotor free to rotate. Test the whimmydiddle by rubbing the notches briskly with the rubbing stick. If the rotor won't turn or reverse properly, continue diminishing the body diameter and/or deepen notches.

skyhook

Many people have heard of a skyhook, the legendary device for supporting a weight without any visible means. A peculiarly-shaped piece of wood, a skyhook balances itself at the end of your finger—but only if a leather belt is hung in its groove. It looks impossible and *feels* even more impossible.

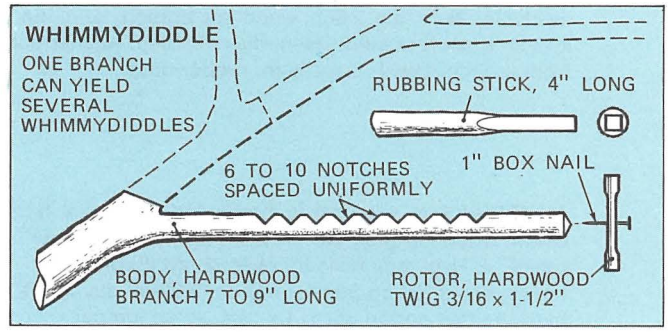
Directions: Use a jigsaw or carve the wood to shape. The edge at the point must be straight, broad and sharp. It works with any leather belt.

flying machine

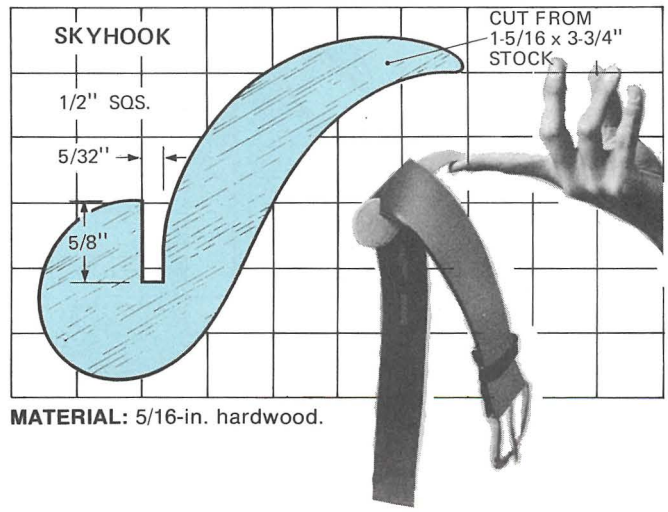
This helicopter-like toy was known before the invention of powered aircraft. Place the dowel between the palms of your hands, rub them together briskly, then release. The propeller rotates and rises into the air.

Directions: Cut the propeller blank to size, marking the exact center point for the shaft. Bore a hole through the propeller, being careful to make it exactly perpendicular to the blade hub. Mark guidelines and carve the propeller, a

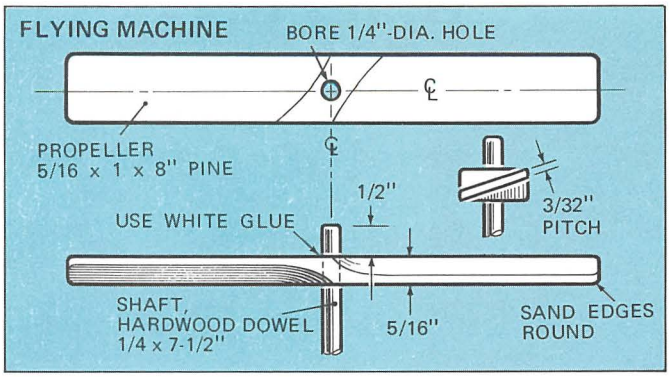
Excerpted from American Folk Toys by Dick Schnacke; hard cover, G.P. Putnam's Sons; paperback, Penguin.


WHIMMYDIDDLE
ONE BRANCH CAN YIELD SEVERAL WHIMMYDIDDLES
RUBBING STICK, 4" LONG
6 TO 10 NOTCHES SPACED UNIFORMLY
1" BOX NAIL
BODY, HARDWOOD BRANCH 7 TO 9" LONG
ROTOR, HARDWOOD TWIG 3/16 x 1-1/2"

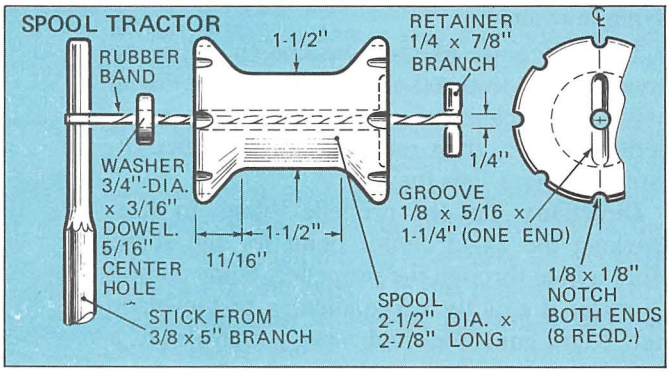
MATERIALS: 7 to 9-in. body; 4-in. rubbing stick; 3/16-in.-dia. x 1½-in. rotor; 1-in. nail.



MATERIAL: 5/16-in. hardwood.



MATERIALS: A piece of 5/16 x 1 x 8-in. white pine for the propeller blade; a ¼-in.-dia. x 7½-in. hardwood dowel for the shaft; white glue to attach the shaft firmly to the propeller.



MATERIALS: 2¾ x 2¾ x 2⅞-in. block of wood for the spool (or a 2½-in.-dia. x 2⅞-in. commercial wood spool if available); ⅜-in.-dia. x 5-in. wood tree branch; ¼-in.-dia. x ⅞-in. branch retainer; ¾-in.-dia. x 3/16-in. washer cut from a birch dowel; ¼ x 2½-in. rubber band.

MATERIALS: ¾ x 2 x 5¾-in. hardwood body; ⅜ x ¾ x 6¾-in. wood hanging bar; 3, ⅝-in.-dia. x ⅝-in. dowel beads; 4, ⅝-in. box nails for eyes; 2 red thumbtack noses; black felt-tip pen for mouth; 5/32-in.-dia. x 9-ft. hard-braided cotton cord; 4 x 5-in. scrap jumper material; 4 small jumper buttons.

little at a time on each side and end. Round the propeller ends and smooth them with sandpaper. Cut the shaft to length from a dowel and taper one end. Insert and glue it into the propeller. Test by rolling the shaft along a tabletop with the propeller turning over the table edge. Adjust blade alignment if not absolutely square with the shaft.

spool tractor

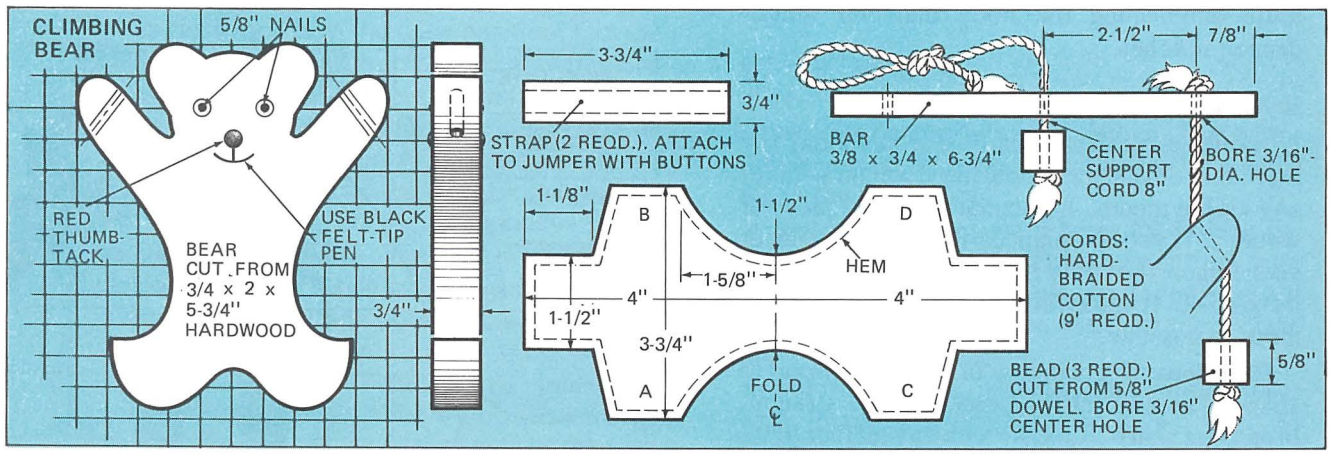
This early-day power toy is made of a wooden spool, a rubber band and a stick. When the assembly is wound and placed on the floor, it becomes a self-powered vehicle and will travel quite a distance.

Directions: Turn a wood spool on a lathe (or use a ready-made spool of proper size). Bore the center hole, carve the notches in the rims and the shallow groove in one end to hold the retainer. Cut the retainer, stick and washer. To assemble the tractor, loop the rubber band around the stick and through the washer. Then pull the rubber band through the spool with a wire hook and anchor it around the retainer which should be positioned in its groove on the spool.

climbing bear

Hang the cord loop on a hook in the wall or ceiling and pull alternately on the cord ends to make the bear climb.

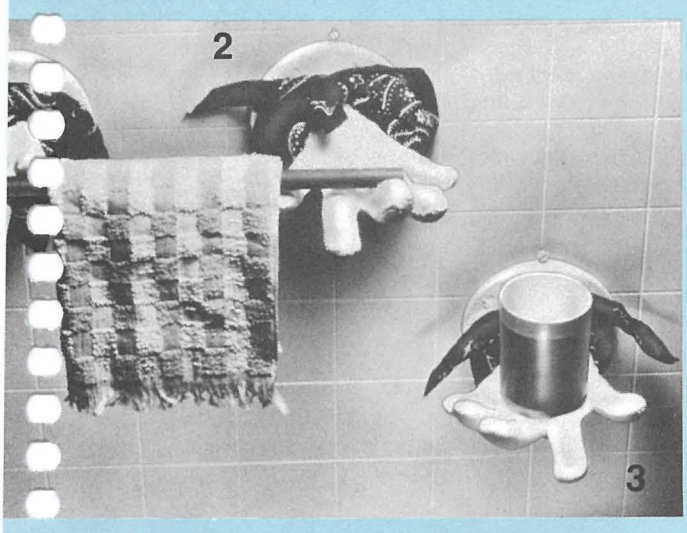
Directions: Lay out and cut wooden parts. Bore holes through the bear's paws, the bar and the beads. Add the face decoration to both sides of the bear. Cut and seam jumper material and sew it on the bear. Cut two lengths of cord, each 50-in. long, and thread them through the bar, bear and beads. Then knot the ends.

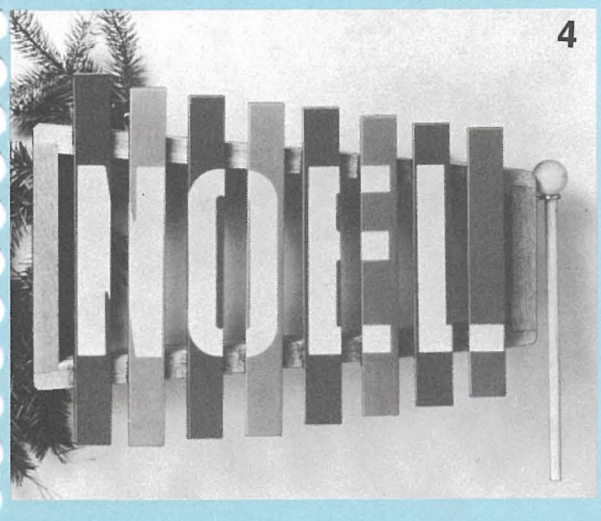


Fun gifts to make for Christmas

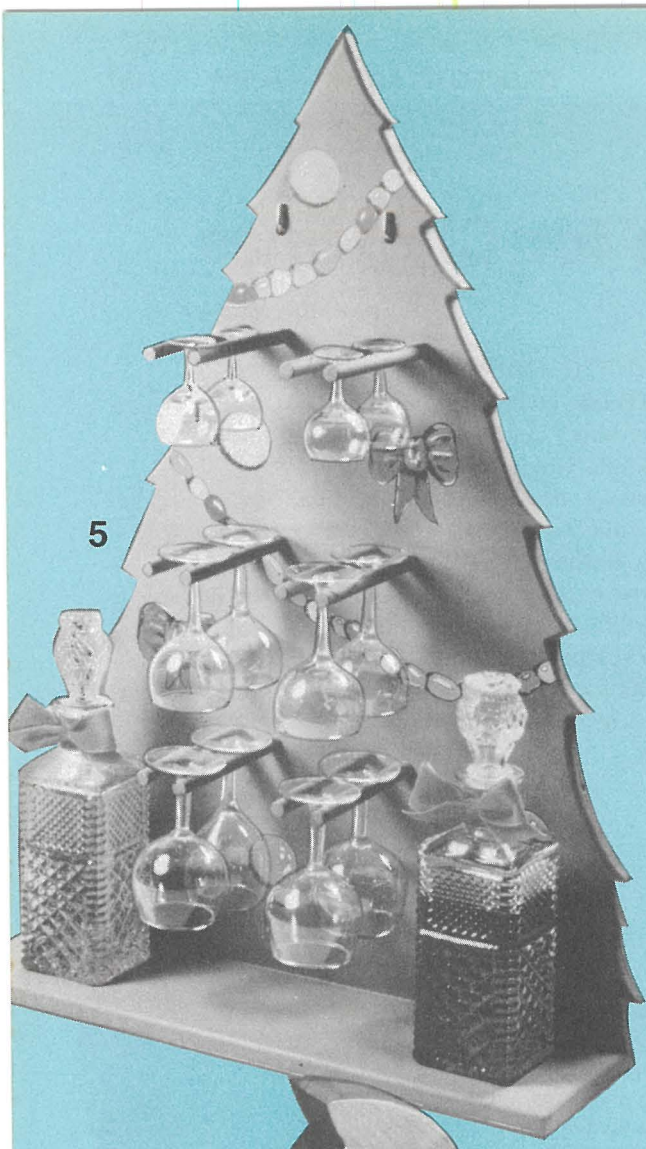
By HARRY WICKS

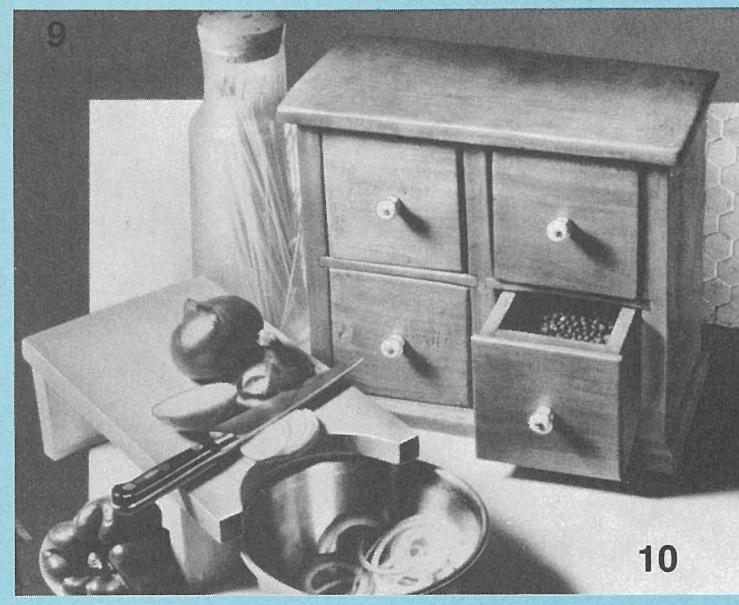
■ ONE OF THE GREAT pleasures for a workshopper, I think, is the joy you get when you give away something you have crafted with your own hands. To help you earn that feeling for yourself this Christmas, or any other Christmas, we've created a collection of attractive, easy-to-make projects. Whether you elect to build something for the house or a toy that a child will treasure the rest of his life, you will have just as much fun making the project as giving it away. Complete instructions for all of the gifts are given on the following pages.



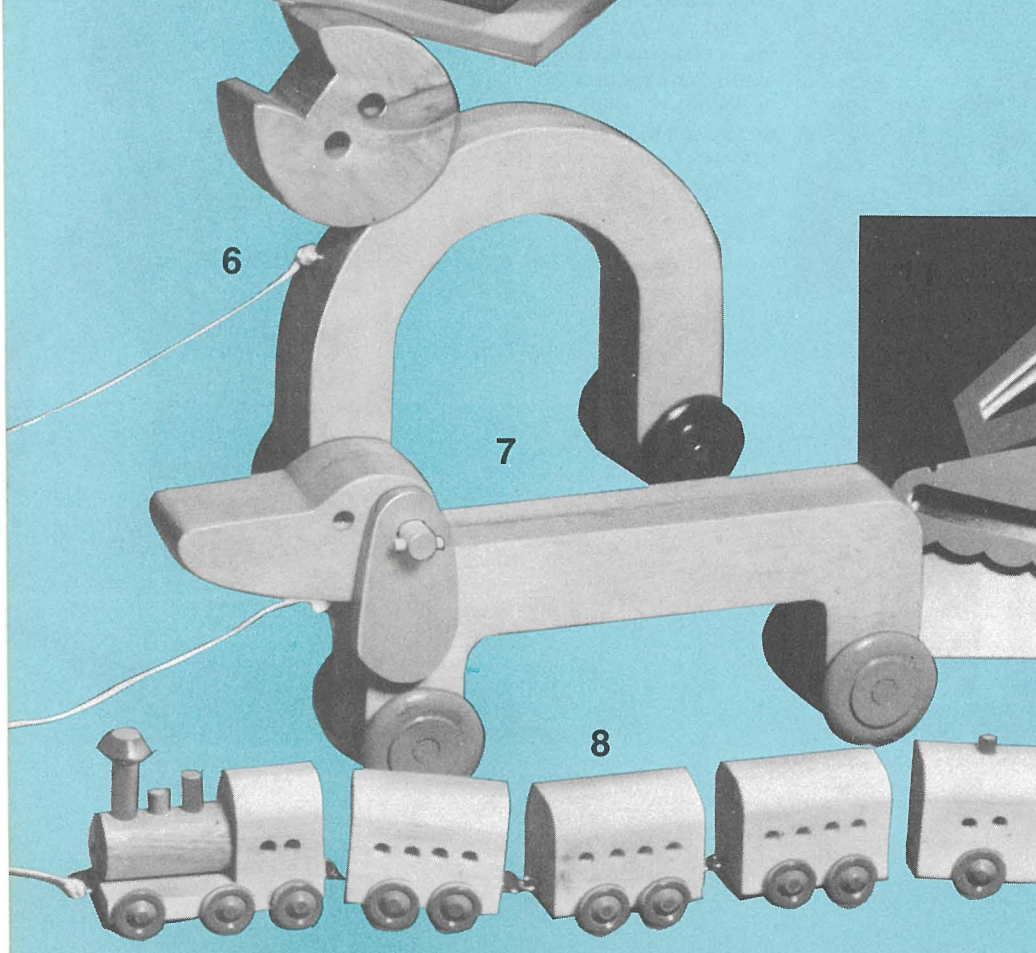


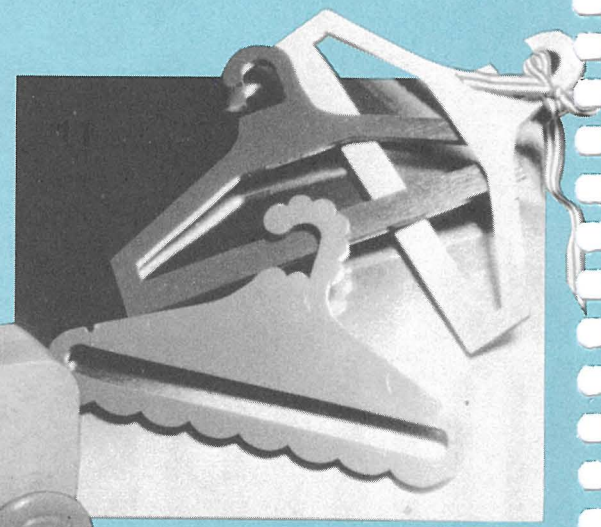
1 OUR REWORDED film-editor's slate can be used as a home movie titler. **2** and **3** Stuffed, plaster-coated gloves make delightful towel and cup holders for a teen-ager's room. **4** Our "xylophone" is more for wall decoration than music making. But toddler can use it after the holidays.





5 HOLIDAY WALL bar adds to party merriment. **6** and **7** Whimsical, stylized cat and dog pull toys are fun to make and play with. **8** A toy train is sure to become a family classic. **9** Our four-drawer spice box, a replica of a pine antique, is fashioned of mellow maple and finished with a satin varnish. **10** Contemporary cutting board is sized to suit the bowl you give with it. When not needed, the stainless-steel bowl stores conveniently between the cutting board legs. **11** These brightly painted hangers are a variation of the plastic hangers sold in boutiques. We used ⅜-in. A-D plywood to make the ones shown; they're finished with a new latex paint that gives a super gloss.





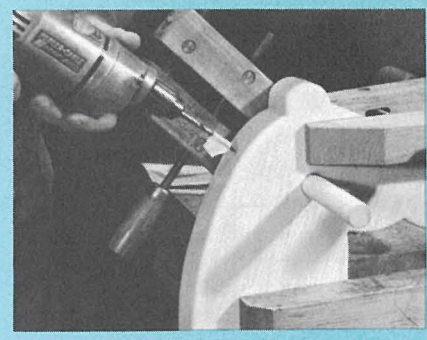
12 Hobby horse

Though the horse is one of the largest projects in our collection, it is also one of the easiest to build. The toughest part of the job is locating the filler strips—D, E, F, G—which are needed to balance the horse in the rest position; this is explained in Step 7.

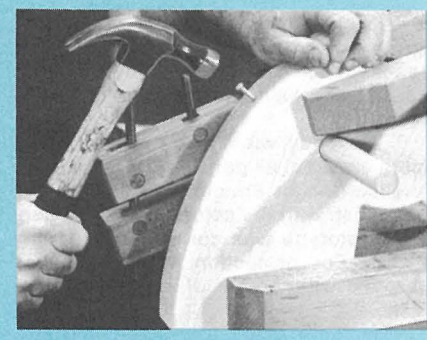
1. Start by gluing up 5/4-in. pine stock for the head. Use white glue and clamps, leave boards clamped overnight.

2. Next day, lay out the head—note grain direction—and make the cutout using either a scroll or sabre saw. Locate and bore holes for eyes and hand bar (H). Sand all pieces and set aside.

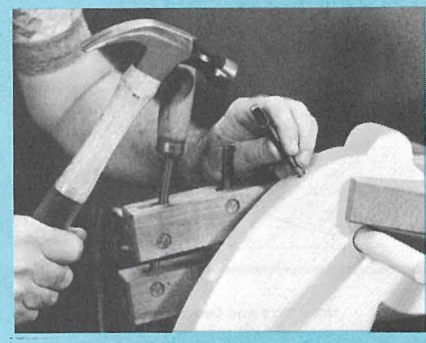
3. Cut two pieces of plywood for the rockers and—in the waste area—tack them together with 1-in. brads. Draw the outline on one side and cut out both sides at this time with a sabre or scroll saw.



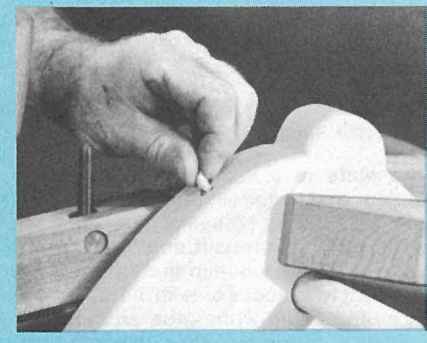
USE CLAMPS to hold hand bar rigid, clamp head in vise, bore hole for dowel.



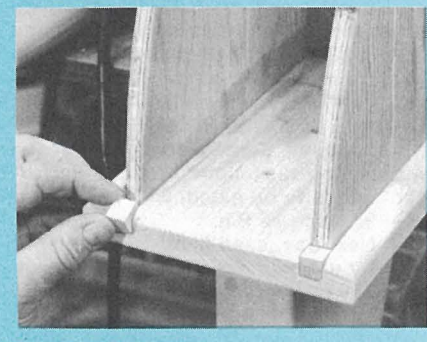
NEXT, bore pilot hole and drive in 16d nail to pin the dowel hand bar.



USE A HEAVY nailset to bury nailhead well into counterbored hole.



CUT DOWEL to suit and install it using a small amount of white glue.



BLIND GROOVES for rocker's sides are created by gluing in small blocks.

4. Check plywood edges for voids and fill if necessary. Sand all edges smooth.

5. Cut the board for the seat and, using dado cutters on the bench saw, plow the pair of grooves to receive the ply rockers.

6. Temporarily assemble the horse using screws (only) up through the seat into the head. Tack with nails through the grooves into ply rockers. Stand horse on level surface and check it for balance.

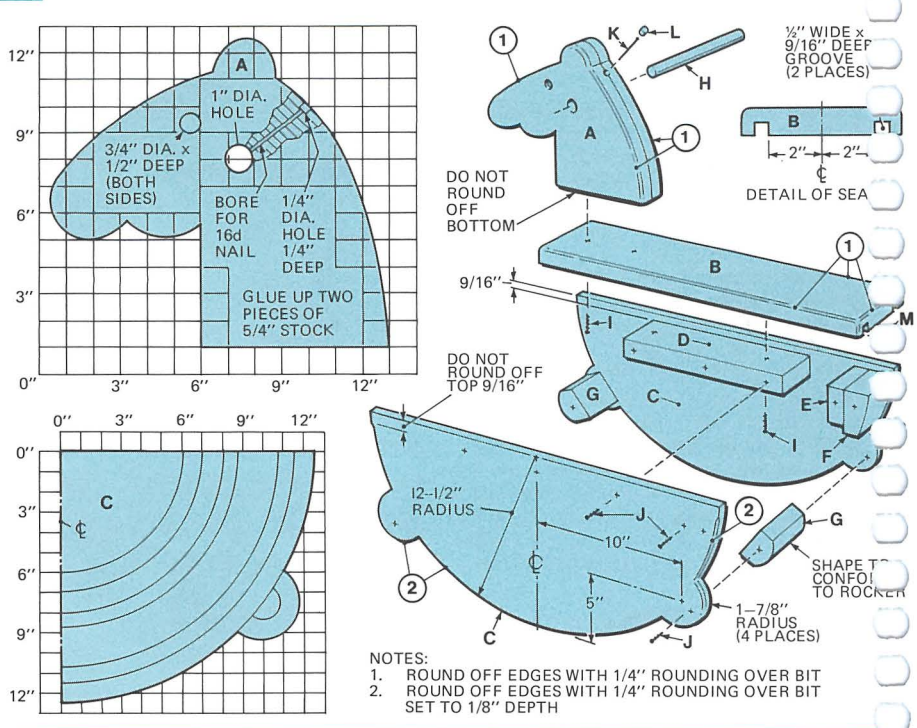
7. To start, cut filler/weight D, E, F and G to the dimensions in the drawing. We used dense oak to limit the volume of wood needed. Position the filler blocks as shown and hold each in place with a screw or two until the horse achieves a near-perfect balance in the rest position. Then, either glue and fasten the blocks permanently to the seat's bottom, or make an accurate measured drawing so you can quickly position and fasten them later.

continued

8. Disassemble the horse and sand all exposed parts smooth. Dust off and reassemble permanently, using glue, screws and nails. Set aside to dry overnight.

9. Next day, wipe the horse with a tack cloth and seal all parts with a pigmented shellac (Bin or Enamelac). Allow to dry and finish with the colors of your choice. The prototype was colored with acrylic paints. For protection, the horse was sprayed with a coat of semi-gloss varnish.

Note: If the rocker is for a toddler who is still at the "chew anything" age, make certain that you don't use toxic materials to finish the horse.



1 Editor's slate

The slate is a simple, straightforward project that requires little material.

1. Cut the two pieces of pine (A) to the sizes shown. Miter-cut end of top piece and plow the groove in the second.

2. Cut two pieces of ⅛-in. hardboard to size, and using white glue and clamps, laminate together. Then smooth surfaces.

3. Temporarily assemble parts when dry. Locate and mark for holes to be bored through hardboard for the nut and bolt "hinge." *Do not* add brads (pins) through hardboard hinge until final assembly. When you're satisfied with the fit and slate operation, disassemble.

4. Sand all parts smooth. Dust and wipe with a tack cloth. Prime them (except edges to be glued) with pigmented shellac, such as Bin.

5. Next day, sand lightly with 180-grit paper, dust and tack off. Using masking tape, lay out the white lines and stripes. Mask all other surfaces. Use Krylon's semigloss paint to spray-paint white areas.

6. When paint is completely dry, carefully cover all white-painted surfaces with masking tape, trim neatly with a utility knife, and press tape edges.

7. Spray the balance of slate with at least two coats of flat black paint.

8. When dry, remove the tape and reassemble. Add brad pins (G) through the hardboard hinge.

9. We used self-stick letters and protected them with spray matte finish.

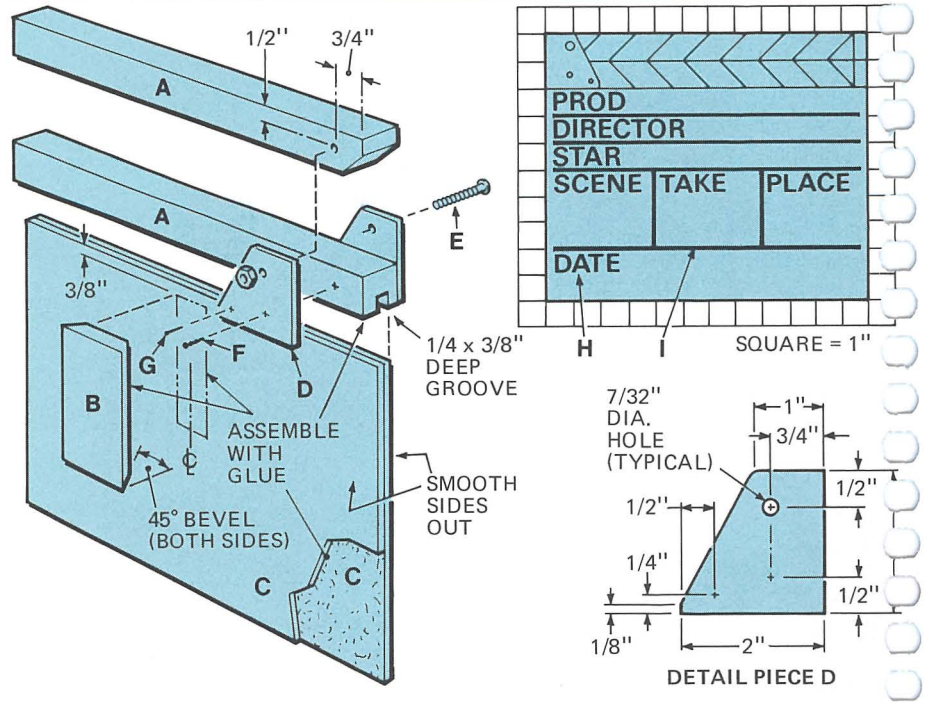
MATERIALS LIST—EDITOR'S SLATE

Key	No.	Size and description
A	2	1 × 1 × 12" pine (cut from ¾" stock)
B	1	¾ × 2 × 4" pine
C	2	⅛ × 8⅜ × 12" hardboard
D	2	⅛ × 2 × 2" hardboard (hinge pieces)
E	1	3/16 × 1½" rh bolt and nut
F	2	⅝" No. 8 rh screw
G	2	½" brads
H		Letraset (white letters) No. 67-72 CN
I		1/16" and 1" wide white tape (optional)

Misc.: Sandpaper, tack cloth, flat spray paints.

MATERIALS LIST—HOBBY HORSE

Key	No.	Size and Description (use)
A	2	¾ × 13 × 13" pine (head)
B	1	¾ × 6 × 26½" pine (seat)
C	2	½ × 12½ × 25" plywood (rockers)
D	1	1⅞ × 4 × 11⅛" oak (cleat)
E	1	1⅛ × 3¾ × 4" oak (cleat)
F	1	1⅛ × 4 × 4¼" oak (cleat)
G	2	1⅛ × 2¾ × 4" oak (spacer)
H	1	1"-dia. × 11⅛" dowel (handbar)
I	4	2" No. 10 panhead screws
J	14	1" No. 10 fh screws
K	1	16d finishing nail
L	1	¼"-dia. wood plug
M	4	½ × 9/16 × ¾" fillers



2 & 3 Plaster hands

1. Glue dowels in holes centered in discs.

2. Stretch glove index finger over dowels.

3. Fill gloves with polyfiber. In cupholder, staple cardboard disc—to create a flat surface—to center of dowel.

4. Stuff gloves to reassemble; staple openings to inside perimeter of wood discs.

5. Mix plaster and dip gloves four times for even coat; set aside, let harden.

6. Insert screw eyes into top of discs.
7. Fold bandanna triangles; tie to hands.
8. Paint towel bar (dowel) red. Hang gloves, set towelholders on index fingers. Set a plastic cup on the cupholder hand.

MATERIALS LIST—PLASTER HANDS

No.	Size and description (use)
3	¾ × 6"-dia. discs (½" pine)
3	½ × 10" dowels (gloves)
1	½ × 16" dowel (towel bar)

Misc.: 5 lbs. Plaster of Paris, 1 bag polyfiber stuffing; large-size soft cotton workgloves, red bandannas; red acrylic paint; staple gun; 3 small screw eyes, one 5"-dia. cardboard disc.

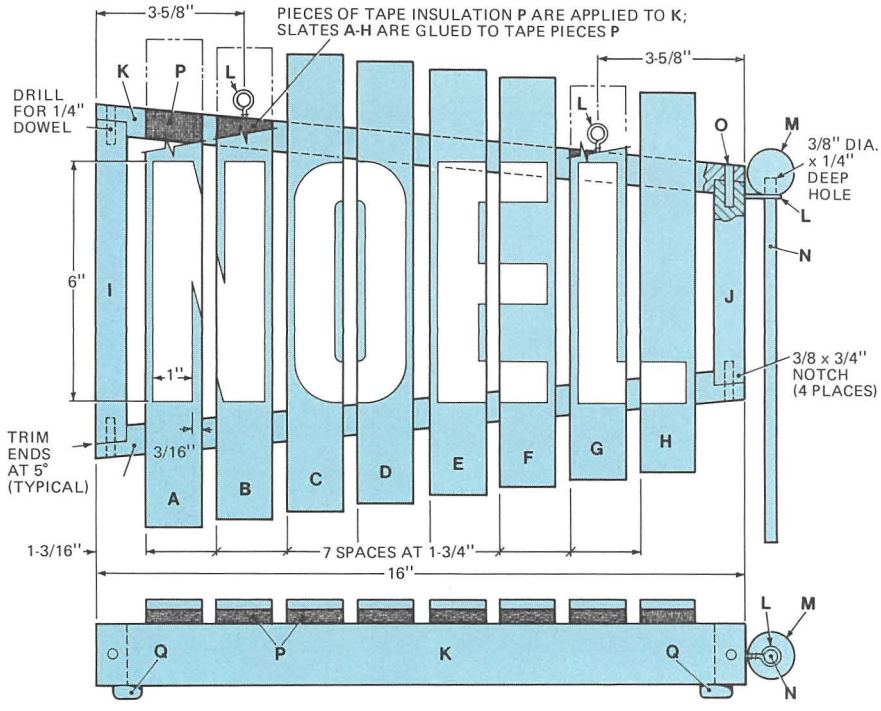
4 Wall xylophone

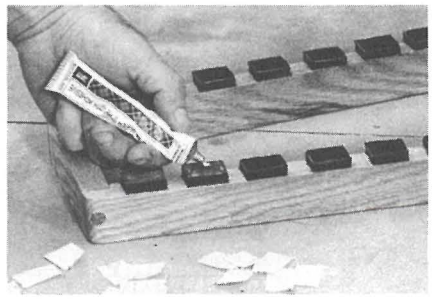
This is a simple toy that doubles as a wall decoration. The separation of wood with weatherstripping, and the different lengths of lattice, give a *slight* tonal variation.

1. Cut parts for base. Oak was used for the prototype. Cut bevel for end rabbets in part K and make repeat passes to required width. Assemble base with glue and dowels. Then sand. Use diagonal braces across two corners to make certain that the unit remains square while glue dries.
2. Sand oak frame, wipe with tack cloth. Seal with two coats of shellac. Let dry overnight before assembling.
3. Cut pieces of lattice to length.
4. Sand, dust and prime lattice strips. Then paint strips red and green.
5. Position small strips of weatherstrip as shown. Use an all-purpose adhesive, such as 3M's Superstrength, to affix strips of lattice to weatherstrip pads. Protect lattice with newspaper and weigh down overnight. Next day, for added strength, bore pilot holes through lattice and weatherstrip and add one 1¼" finishing nail at each end of all lattice strips.
6. Add toilet seat bumper "feet," install one screw eye for hanging mallet and two screw eyes for hanging xylophone.
7. The mallet is made with a commercial wooden ball and a short length of ⅜-in. dowel glued into a predrilled hole. You can purchase the ball at a craft-supply house.

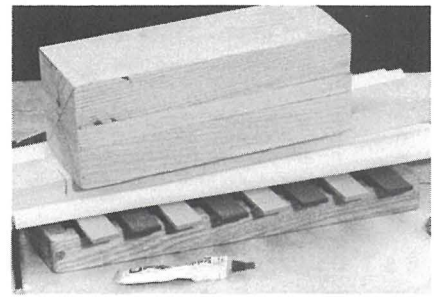
MATERIALS LIST—XYLOPHONE

Key	No.	Size and description
A	1	¼ × 1⅜ × 12" pine lattice
B	1	¼ × 1⅜ × 11⅝" pine lattice
C	1	¼ × 1⅜ × 11¼" pine lattice
D	1	¼ × 1⅜ × 10⅞" pine lattice
E	1	¼ × 1⅜ × 10½" pine lattice
F	1	¼ × 1⅜ × 10⅛" pine lattice
G	1	¼ × 1⅜ × 9¾" pine lattice
H	1	¼ × 1⅜ × 9⅜" pine lattice
I	1	¾ × 1½ × 8" oak
J	1	¾ × 1½ × 5⅛" oak
K	2	¾ × 1½ × 16⅛" oak
L	3	⅜" i.d. screw eye
M	1	1⅛"-dia. wood ball
N	1	⅜"-dia. × 9¾" dowel
O	4	¼"-dia. × 1" dowel
P	18	⅜"-thick weatherstripping
Q	4	Nylon toilet-seat bumper

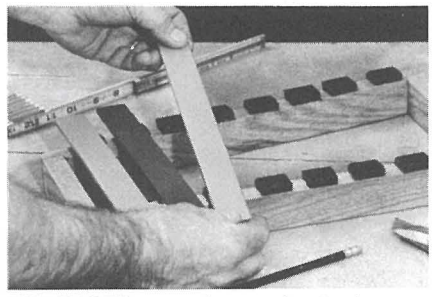




APPLY SQUARES of weatherstripping to frame and put adhesive on top surfaces.



ALLOW GLUE to set several seconds. Then put slats in position on the squares.

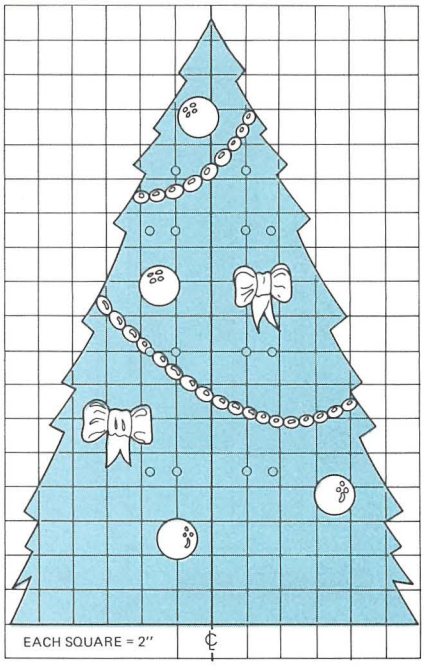


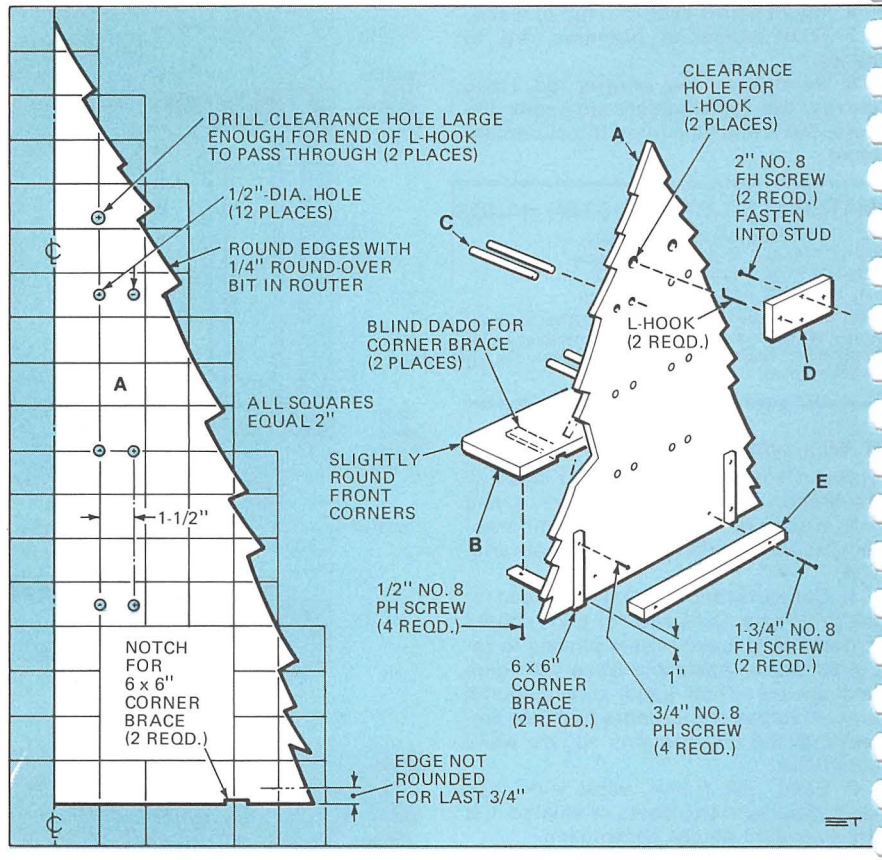
PUT PAPER over slats and set a heavy weight on the top overnight.

5 Christmas-tree wall bar

1. Using the grid, lay out tree shape on A-D or cabinet-grade plywood. Cut with scroll or sabre saw, fill edge voids with plastic wood filler, sand smooth.
2. Round front edges with rounding bit and router, or block plane, file and sand.
3. Cut the stock for the bar and lay out for the corner brace notches.
4. Notch bar and plywood back with a router. Install bar on tree with screws.
5. Carefully lay out for dowel (glass-holding) rack holes. (Note: Check stemware *before* boring holes. The dowels must be closer for small glasses.) Cut saw kerf ⅜-in. deep in end of each dowel.
6. Apply white glue to kerfed dowel ends; insert dowels in holes. Secure dowels in kerfed ends with wedges from back. Let dry overnight. Prime-paint wood with pigmented shellac (Bin or Enamelac). Let dry, sand lightly with 180-grit paper, dust, tack.
7. Apply a coat of latex green to wooden parts and allow to dry overnight.
8. Use grid drawing to lay out and draw tree "ornaments" on tracing paper. Tape drawings in place on tree with carbon paper beneath. Transfer design with pencil.
9. Use acrylic paints to paint the tree decoration.
10. Install hangers as shown. Securely mount wall bracket with screws into a wall stud.

continued




DRILL CLEARANCE HOLE LARGE ENOUGH FOR END OF L-HOOK TO PASS THROUGH (2 PLACES)
1/2"-DIA. HOLE (12 PLACES)
ROUND EDGES WITH 1/4" ROUND-OVER BIT IN ROUTER
ALL SQUARES EQUAL 2"
1-1/2"
NOTCH FOR 6 x 6" CORNER BRACE (2 REQD.)
EDGE NOT ROUNDED FOR LAST 3/4"
CLEARANCE HOLE FOR L-HOOK (2 PLACES)
2" NO. 8 FH SCREW (2 REQD.) FASTEN INTO STUD
L-HOOK (2 REQD.)
BLIND DADO FOR CORNER BRACE (2 PLACES)
SLIGHTLY ROUND FRONT CORNERS
1/2" NO. 8 PH SCREW (4 REQD.)
6 x 6" CORNER BRACE (2 REQD.)
1"
3/4" NO. 8 PH SCREW (4 REQD.)
1-3/4" NO. 8 FH SCREW (2 REQD.)
A
B
C
D
E

MATERIALS LIST—TREE WALL BAR

Key	No.	Size and description (use)
A	1	½ × 24 × 36" plywood (tree)
B	1	¾ × 5 × 24" clear pine (bar)
C	12	½ × 8" dowels (hangers)
D	1	¾ × 5 × 6" (wall cleat)
E	1	¾ × 1½ × 20" (standoff cleat)

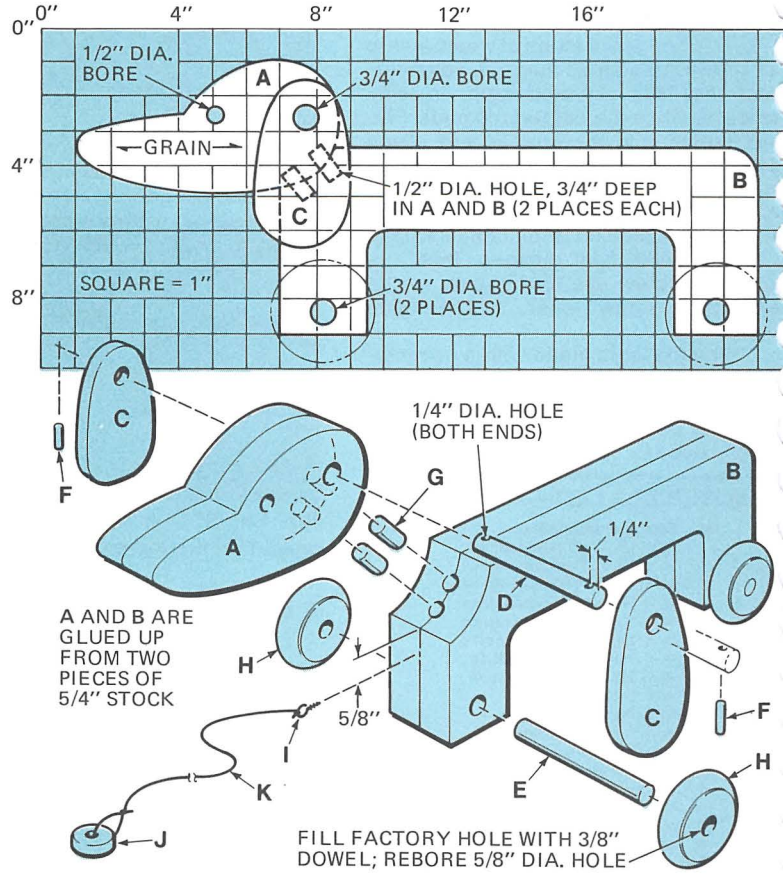
Misc.: Pigmented shellac (Bin), green latex paint, acrylic paint colors, hardware (see drawing)

6 & 7 Dog and cat

For ease of construction, both pull toys are made using glued up 5/4-in. stock. You can substitute thicker pine, if available, but the cost will be greater. Directions are basically the same for both.

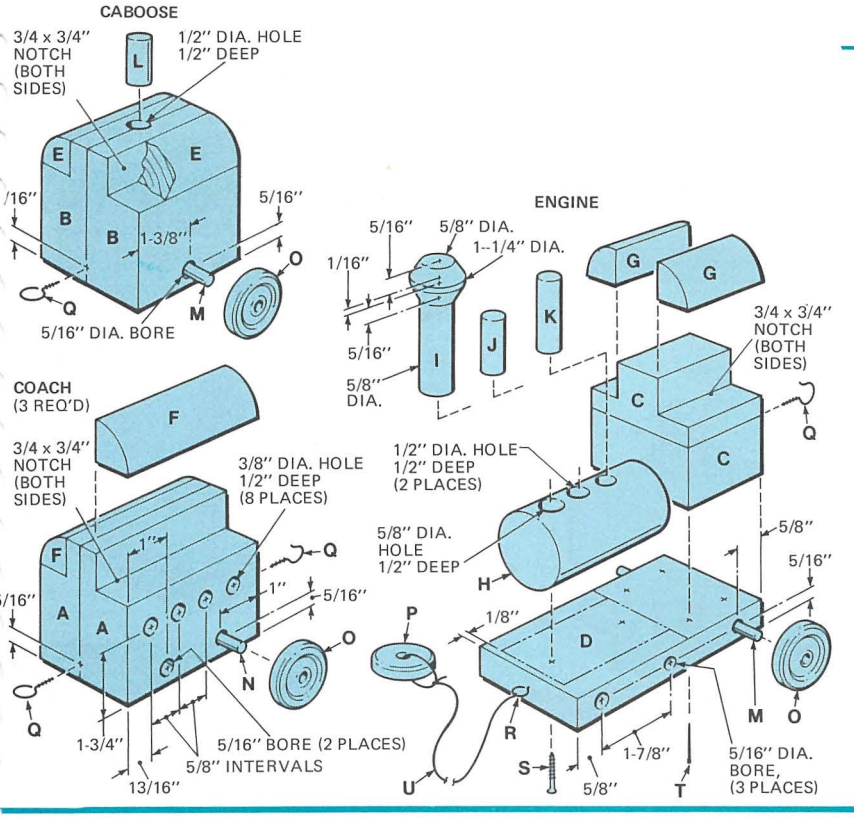
1. Lay out the animal's head on a piece of 5/4-in. stock, making certain that the grain is running in the right direction. Make a square cutoff and cut a second piece for lamination to the first.

2. Apply white glue sparingly to both surfaces and press the boards together. Using scrap-wood pads beneath the jaws to protect the wood, apply pressure to the parts with clamps. Set aside to dry overnight. Repeat this procedure for the body.



MATERIALS LIST—DOG PULL TOY

Key	No.	Size and description
A	2	¾ × 4 × 8" pine
B	2	¾ × 5½ × 14" pine
C	2	½ × 3 × 5" plywood
D	1	⅝"-dia. × 4¼" ear dowel
E	2	⅝"-dia. × 3⅞" axle dowels
F	2	¼"-dia. × 1" dowel
G	2	½"-dia. 1¼" dowel
H	4	3"-dia. wheel, Love-Built WP-19
I	1	No. 10 screw eye
J	1	1"-dia. wheel
K	1	34" drapery cord



MATERIALS LIST—PULL TRAIN

Key	No.	Size and description
A	6	1 1/16 × 2¾ × 3½" (2 each coach)
B	2	1 3/16 × 2¾ × 2¾"
C	2	1 3/16 × 2 × 2"
D	1	⅝ × 2⅜ × 5"
E	2	¾ × ¾ × 2¾" quarter round
F	6	¾ × ¾ × 3½" quarter round (2 each coach)
G	2	¾ × ¾ × 2" quarter round
H	1	1⅝"-dia. × 2⅞" closet pole
I	1	Smokestack, Love-Built STK: 2
J	1	½"-dia. × 1⅛" dowel
K	1	½"-dia. × 1½" dowel
L	1	½"-dia. × ⅞" dowel
M	4	¼"-dia. × 3¼" dowel (3-engine, 1 caboose)
N	6	¼"-dia. × 3" dowel, 2 each coach
O	20	1¼"-dia. wheels, Love-Built No. W16
P	1	1"-dia. wheel, Love-Built, No. W15
Q	4 sets	No. 10 screw eye & hooks
R	1	No. 10 screw eye
S	2	1" No. 8 fh screw
T	4	1¼" No. 18 brads

Misc.: 34" drapery cord, white glue, sandpaper, shellac, paint.

3. The next day, cut out the animal parts using a sabre or scroll saw. Be certain to make the outside outline cuts first, and bore the dowel holes for the neck joints before making the inside outline cutouts which form the animals' legs. When all parts are cut, sand them smooth with 120-grit paper, dust and tack off.

4. Bore axle, ear and eye holes.

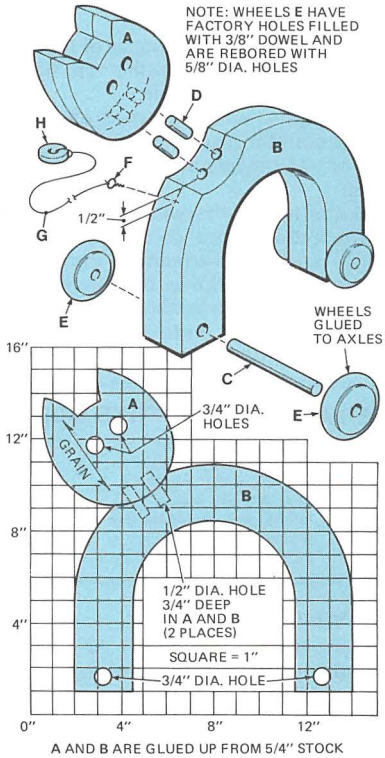
5. Seal all wooden parts with white shellac, thinned 50-percent with denatured alcohol. Allow to dry. Next day, finish animal bodies with satin-finish varnish. Let them dry.

6. Install screw-eye, add pull cord and wheel button. Glue one wheel to the end of each axle and insert dowel into axle hole. Add the second wheel.

7. On the dog, add ears. Set the toy aside to dry for at least 24 hours before gift-wrapping.

MATERIALS LIST—CAT PULL TOY

Key	No.	Size and description
A	2	¼ × 6 × 6"
B	2	¼ × 10 × 12"
C	2	⅝"-dia. × 3⅞" dowel
D	2	½"-dia. × 1¼" dowel
E	4	3"-dia. wheel, Love-Built WP-19
F	1	No. 10 screw-eye
G	1	34" drapery cord
H	1	1"-dia. wheel


NOTE: WHEELS E HAVE FACTORY HOLES FILLED WITH 3/8" DOWEL AND ARE REBORED WITH 5/8" DIA. HOLES
WHEELS GLUED TO AXLES
3/4" DIA. HOLES
GRAIN
1/2" DIA. HOLE 3/4" DEEP IN A AND B (2 PLACES)
SQUARE = 1"
3/4" DIA. HOLE
A AND B ARE GLUED UP FROM 5/4" STOCK

8 Pull train

The shapes for this train are created using standard lumberyard materials so you have very little cutting to do:

1. Start by gluing up stock for one engine, three cars and a caboose. Use white glue and clamp the parts overnight.

2. On cars to be rounded, cut the ¾ × ¾-in. edge rabbets along both top edges to receive the ¾-in. quarter-round molding. Install the molding, using glue and 1-in. brads.

3. Cut parts for the engine and install them with glue and brads. Use masking tape to hold the parts while glue dries.

4. Locate and bore the 5/16-in. axle holes through the bodies. Sand all parts smooth, dust and wipe with a tack cloth.

5. Seal all wood parts with 3-lb.-cut white shellac thinned 50 percent with denatured alcohol. The next day lightly sand all parts with 180-grit sandpaper, dust, wipe with a tack cloth. Apply a second unthinned coat of shellac to all parts which will be left natural.

6. Paint the wheels and engine parts, using latex paint. When dry, the latex-painted parts can be coated with a thin coat of satin-finish varnish.

7. Glue one wheel on each axle (N) and insert axle into axle hole. Glue on second wheel.

8. Locate and bore pilot holes and install screw eyes and hooks. Cut the pull cord to a suitable length and add a wheel for sure gripping.

9 Colonial spice box

Most Colonial spice boxes of this type are fashioned of pine. However, for sheer elegance, we constructed ours of maple.

1. Start by cutting all parts to size, as shown in the drawing. To make assembly easier, mark all pieces with code letters.

2. Use an ogee cutter in your router to shape the top and bottom edges as shown. Rout the back edges of the sides to receive the ¼-in. plywood back.

3. Temporarily assemble the top, bottom, sides, center dividers and back to check for fit—and to make measurements for the drawers. Adjust the dimensions until you're satisfied with the fit and squareness of unit. Then disassemble.

4. Sand all parts smooth and reassemble the box, using glue and clamps to hold the case securely until the glue dries. The next day, bore holes and install screws as shown. Add dowel plugs. (Note: Since our box is made of maple, we made our own dowel plugs, using a plug cutter in the drill press and a scrap of maple.)

5. With the box assembled, the drawers can be built. First assemble them dry for a test fit, then permanently with glue and brads. Use match numbers for drawers. Each one should be fitted so it will be returned to its mating pigeon hole.

6. Check all parts for smoothness.

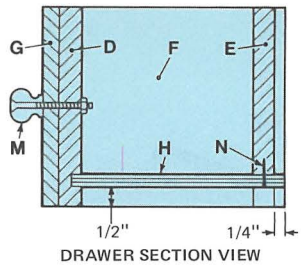
continued

Sand if necessary to bring the hardwood to a glass-like smoothness. Make a final dusting and wipe off all the parts with a tack cloth.

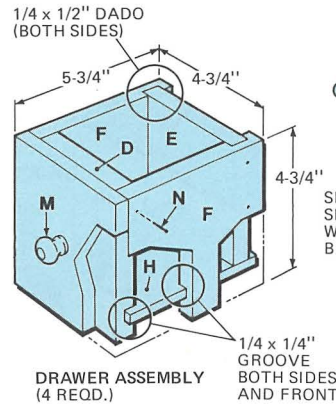
7. The unit shown was finished as follows: a) all wooden parts were sealed with a coat of shellac thinned 50 percent with denatured alcohol; b) dry shellac was sanded lightly using 180-grit paper, dusted and tacked off; c) a coat of Pratt and Lambert satin-finish varnish was applied, as it came from the can, and allowed to dry for 24 hours; d) a light sanding with 220-grit paper followed; e) after dusting and tacking, a second coat of the varnish was applied, as it came from the can.

Allow the box to dry at least 48 hours before putting it into service.

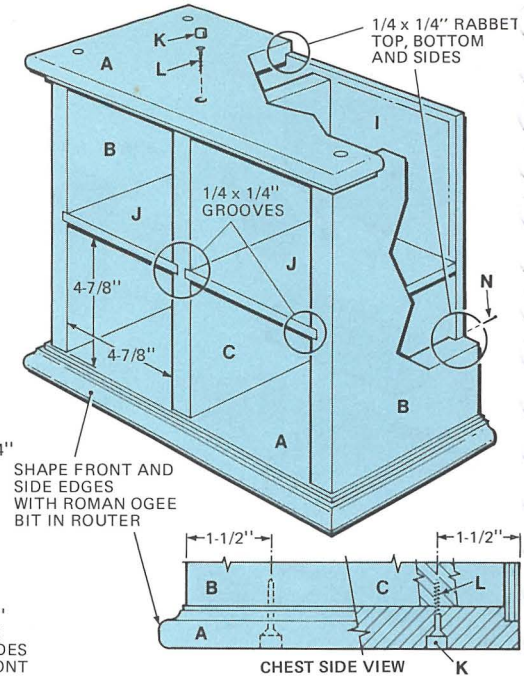
Note: The finish has the look of hand-rubbed wax, but if you're a purist who insists upon waxing his Colonial reproductions, it's a good idea to wait at least three weeks before waxing.



DRAWER SECTION VIEW



DRAWER ASSEMBLY
(4 REQD.)



CHEST SIDE VIEW

MATERIALS LIST— COLONIAL SPICE BOX

Key	No.	Size and description (use)
A	2	¾ × 6½ × 13" (top, bottom)
B	2	¾ × 6 × 10" (side)
C	1	¾ × 5¾ × 10" (vertical divider)
D	4	½ × 3¾ × 4¾" (drawer front)
E	4	½ × 4 × 4¼" (drawer back)
F	8	½ × 4¾ × 5⅜" (drawer side)
G	4	⅜ × 4¾ × 4¾" (drawer face)
H	4	¼ × 4¼ × 5⅛" (drawer bottom)
I	1	¼ × 10½ × 11" (cabinet back)
J	2	¼ × 5⅜ × 5¾" (horizontal divider)
K	12	⅜"-dia. dowel plug
L	12	1" No. 8 fh screw
M	4	¾"-dia. ceramic knob, Amerock T705
N		¾" brads (as required)

10 Cutting board

For practical reasons, use a close-grained hardwood, such as maple or cherry for the cutting board. Start by buying the bowl and design half-moon cutout and leg spacing to suit bowl dimensions.

1. Lay out and cut parts for the legs and top, using the drawing as a guide.

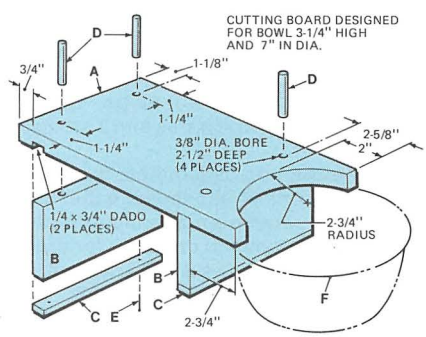
2. Plow the dadoes in the top's underside, using the dado head mounted on the bench saw. To prevent excessive splintering on the edge (where the cutters leave the board), butt a second board tightly against the board being cut.

3. Sand all parts smooth. Start with 100-grit paper; increase fineness to 120 and then 180. Dust off. Tack.

4. Using white glue and 1-in. brads, attach the cleats to the bottoms of the two legs. Then attach legs to the top, using glue and clamp overnight.

5. Next day, remove clamps and bore holes for counterbored screws and dowel plugs (or use dowels alone to secure top to legs).

6. Since foodstuffs will be in contact with the cutting board, *do not* use a toxic material such as varnish to finish the piece. Instead, rub the wood with mineral oil. You should wash the board after each use with soap and water, then periodically re-oil it with mineral oil.



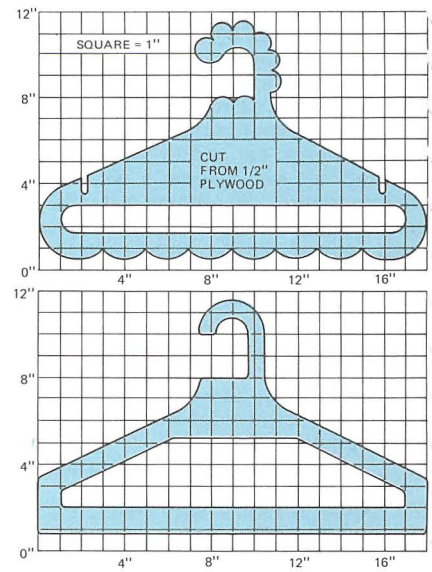
MATERIALS LIST—CUTTING BOARD

Key	No.	Size and description
A	1	¾ × 6⅞ × 12½" maple
B	2	¾ × 3¼ × 6⅞" maple
C	2	⅜ × ¾ × 6⅞" maple
D	4	⅜"-dia. × 2" maple panels
E	4	¾" brad
F	1	S/S bowl 7"-dia. × 3¼" high

11 Hangers

Our hangers are made of ½-in. A-C plywood, but you could laminate ¼-in. hardboard back to back if you want both surfaces smooth. Lay out the hangers using the grids above, and make the cutouts with either scroll or sabre saw. Sand all edges smooth (and fill voids in plywood edges with plastic wood filler).

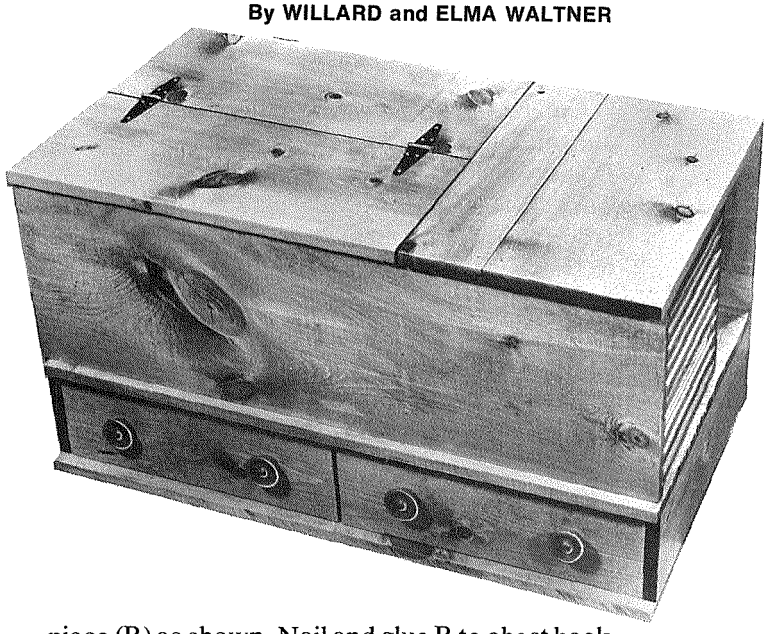
Prime paint with a pigmented shellac, allow to dry and lightly sand-dust and tack off. For a high gloss, we sprayed the hangers shown with LeSpray paints.



SIMPLE LINES and stained pine boards give the toy chest an Early American look. When the kids are grown, it can be used for seasonal storage. It's practically a family heirloom from the start!

Build a rugged colonial toy chest

By WILLARD and ELMA WALTNER



■ YOU'LL APPRECIATE how many toys stay off the floor and out of your way when your kids use this colonial toy chest. Children love its sliding shelves and spacious storage for all their toys and games. And with its compact size and fashionable design, the chest can be put to other uses when the youngsters are grown and gone.

The upper toy compartment is shallow enough so that a child doesn't have to dig deep to get the toy he wants. The half-lid top folds back on itself, decreasing the chance of its falling back down and slamming fingers. Two bottom drawers provide additional storage space, and an open compartment at one end has 10 sliding shelves for puzzles and game boards as well as space for oversized children's books. The colonial chest was designed by Anthony Epp.

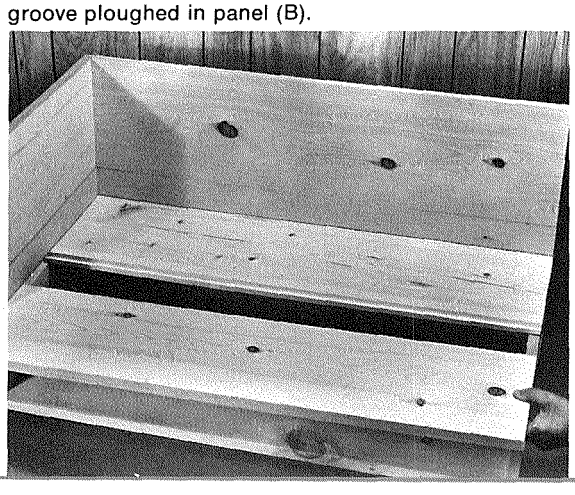
Except for the drawer bottoms and the sliding shelves, which are made of ¼-in.-thick plywood, the chest is built entirely from ¾-in.-thick pine stock. To create the wide boards, edge-join 1x6 boards using lap joints. Use white carpenter's glue and clamp overnight.

Next, cut lumber to dimensions given in the materials list and drawing. Cut the groove in end piece (B) as shown. Nail and glue B to chest back (C). Turn the assembly upside down and nail and glue the chest bottom (A) to B and C. The front edge of A should protrude ¾ in. beyond the front edge of B. Nail and glue the drawer compartment end (E) to A and C.

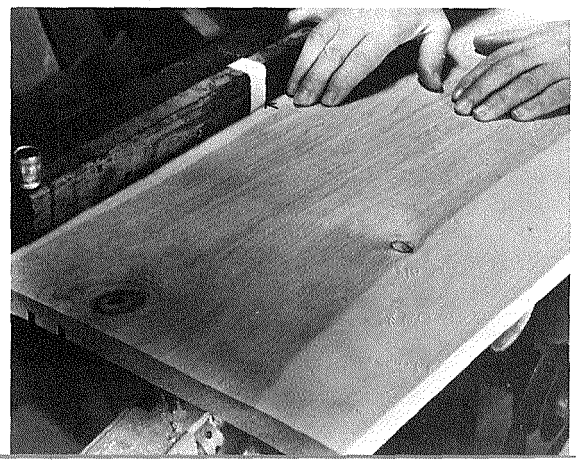
The toy chest bottom (F), which also functions as the top of the drawer compartment, slides into the groove in B as shown. Nail and glue F to B, C and E. The front edge of F should also protrude ¾ in. Next, abut the drawer compartment divider (G) as shown between A and F. Nail and glue G to A, C and F.

Cut 10 13-in.-long grooves along the inner side of front piece (D) and on one side of open compartment divider (I) as shown. These grooves

SHELF (F) between the chest and drawer areas is let into a groove ploughed in panel (B).



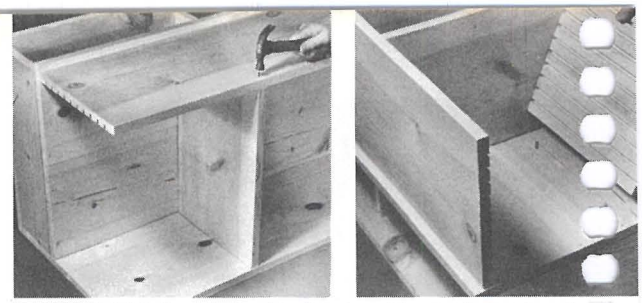
USE A DADO head on a table saw to groove the chest front piece (D) and divider (I).



will accommodate sliding shelves for game boards, puzzles and larger nursery books. Some shelves can be removed to accommodate larger puzzles or game boxes. To cut the blind grooves to proper length on a table saw, mark an arrow on the wood 13 in. from the end. Place a piece of masking tape on the rip fence opposite the center of the saw blade or dado head. Then, with each pass, feed in the wood until the arrow just lines up with the tape.

Cut rabbet in D where it attaches to B as shown. Turn chest assembly upside down and fit D into position. Drive nails through F and D. Turn chest right side up and glue and nail B to D. Insert toy compartment end (H) and glue and nail to D and C. Glue and nail I in place. Nail on the open compartment top (J). Nail on the back lid of the toy compartment (K) and hinge the front lid to the back lid.

Cut dadoes and grooves in the fronts and sides of the drawer pieces as shown. Assemble with nails and glue. Turn drawer knobs on a lathe, using contrasting wood for a decorative effect if desired. Countersink screws to attach knobs as shown. PM's colonial toy chest will last for years and become a favorite family heirloom.

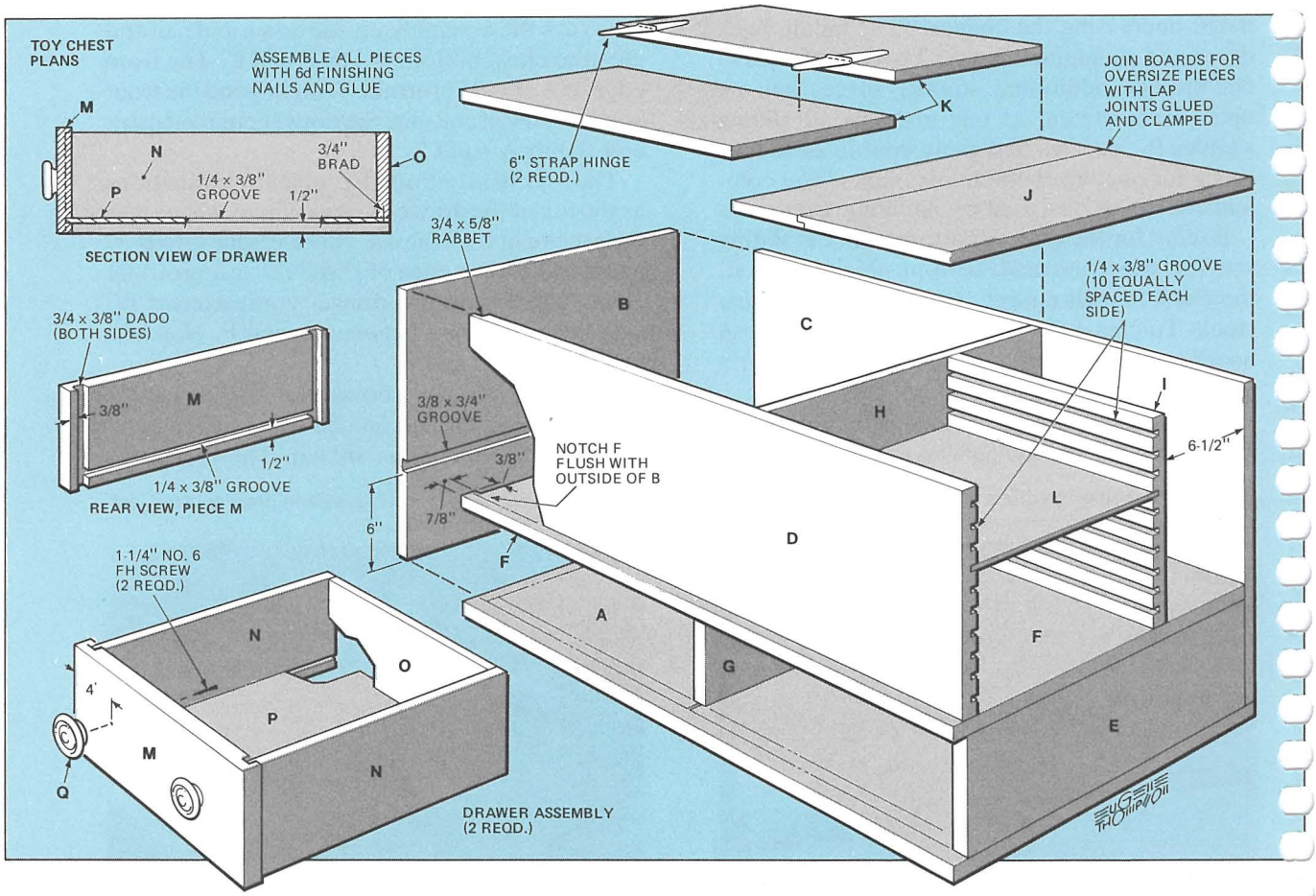


DIVIDER (H) is butt-joined to front and back of chest and held with nails and glue as in photo at left. Install the compartment divider (I) as shown at the right using dowels, nails and glue.

MATERIALS LIST—TOY CHEST

Key	Pcs.	Size and description (use)
A	1	¾ x 19½ x 36″ pine (chest bottom)*
B	1	¾ x 18 x 18″ pine (end)*
C	1	¾ x 18 x 36″ pine (back)*
D	1	¾ x 11¼ x 36″ pine (front)
E	1	¾ x 6 x 18″ pine (end)
F	1	¾ x 18¾ x 36″ pine (toy compartment bottom)*
G	1	¾ x 6 x 17¼″ pine (drawer compartment divider)
H	1	¾ x 11¼ x 18″ pine (toy compartment end)
I	1	¾ x 11¼ x 13″ pine (open compartment divider)
J	1	¾ x 13⅜ x 19½″ pine (open compartment top)*
K	2	¾ x 9¾ x 22½″ pine (toy compartment lids)
L	10	¼ x 10¾ x 13″ plywood (shelves)
M	2	¾ x 5¾ x 17¼″ pine (drawer fronts)
N	4	¾ x 5½ x 17⅜″ pine (drawer sides)
O	2	¾ x 4¾ x 15″ pine (drawer backs)
P	2	¼ x 15¾ x 17⅜″ plywood (drawer bottoms)
Q	2	2″-diameter ¾″ pine (drawer knobs)

Misc.: 2, 6″ strap hinges; 4, 1¼″ fh screws; 6d finishing nails and white carpenter's glue as needed.
*Edge-join 1x6 boards; rip to indicated width.


TOY CHEST PLANS
ASSEMBLE ALL PIECES WITH 6d FINISHING NAILS AND GLUE
JOIN BOARDS FOR OVERSIZE PIECES WITH LAP JOINTS GLUED AND CLAMPED
6" STRAP HINGE (2 REQD.)
SECTION VIEW OF DRAWER
3/4" BRAD
1/4 x 3/8" GROOVE
1/2"
3/4 x 5/8" RABBET
3/4 x 3/8" DADO (BOTH SIDES)
REAR VIEW, PIECE M
1/4 x 3/8" GROOVE (10 EQUALLY SPACED EACH SIDE)
3/8 x 3/4" GROOVE
NOTCH F FLUSH WITH OUTSIDE OF B
6-1/2"
1-1/4" NO. 6 FH SCREW (2 REQD.)
DRAWER ASSEMBLY (2 REQD.)

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METRIC CONVERSION

Conversion factors can be carried so far they become impractical. In cases below where an entry is exact it is followed by an asterisk (*). Where considerable rounding off has taken place, the entry is followed by a + or a - sign.

CUSTOMARY TO METRIC

Linear Measure

inches	millimeters
1/16	1.5875*
1/8	3.2
3/16	4.8
1/4	6.35*
5/16	7.9
3/8	9.5
7/16	11.1
1/2	12.7*
9/16	14.3
5/8	15.9
11/16	17.5
3/4	19.05*
13/16	20.6
7/8	22.2
15/16	23.8
1	25.4*

inches	centimeters
1	2.54*
2	5.1
3	7.6
4	10.2
5	12.7*
6	15.2
7	17.8
8	20.3
9	22.9
10	25.4*
11	27.9
12	30.5

feet	centimeters	meters
1	30.48*	.3048*
2	61	.61
3	91	.91
4	122	1.22
5	152	1.52
6	183	1.83
7	213	2.13
8	244	2.44
9	274	2.74
10	305	3.05
50	1524*	15.24*
100	3048*	30.48*

1 yard = .9144* meters
1 rod = 5.0292* meters
1 mile = 1.6 kilometers
1 nautical mile = 1.852* kilometers

Fluid Measure

(Milliliters [ml] and cubic centimeters [cc or cu cm] are equivalent, but it is customary to use milliliters for liquids.)

1 cu in = 16.39 ml
1 fl oz = 29.6 ml
1 cup = 237 ml
1 pint = 473 ml
1 quart = 946 ml
= .946 liters
1 gallon = 3785 ml
= 3.785 liters
Formula (exact):
fluid ounces × 29.573 529 562 5* = milliliters

Weights

ounces	grams
1	28.3
2	56.7
3	85
4	113
5	142
6	170
7	198
8	227
9	255
10	283
11	312
12	340
13	369
14	397
15	425
16	454

Formula (exact):
ounces × 28.349 523 125* = grams

pounds	kilograms
1	.45
2	.9
3	1.4
4	1.8
5	2.3
6	2.7
7	3.2
8	3.6
9	4.1
10	4.5

1 short ton (2000 lbs) = 907 kilograms (kg)
Formula (exact):
pounds × .453 592 37* = kilograms

Volume

1 cu in = 16.39 cubic centimeters (cc)
1 cu ft = 28 316.7 cc
1 bushel = 35 239.1 cc
1 peck = 8 809.8 cc

Area

1 sq in = 6.45 sq cm
1 sq ft = 929 sq cm
= .093 sq meters
1 sq yd = .84 sq meters
1 acre = 4 046.9 sq meters
= .404 7 hectares
1 sq mile = 2 589 988 sq meters
= 259 hectares
= 2.589 9 sq kilometers

Kitchen Measure

1 teaspoon = 4.93 milliliters (ml)
1 Tablespoon = 14.79 milliliters (ml)

Miscellaneous

1 British thermal unit (Btu) (mean) = 1 055.9 joules
1 calorie (mean) = 4.19 joules
1 horsepower = 745.7 watts
= .75 kilowatts
caliber (diameter of a firearm's bore in hundredths of an inch) = .254 millimeters (mm)
1 atmosphere pressure = 101 325* pascals (newtons per sq meter)
1 pound per square inch (psi) = 6 895 pascals
1 pound per square foot = 47.9 pascals
1 knot = 1.85 kilometers per hour
25 miles per hour = 40.2 kilometers per hour
50 miles per hour = 80.5 kilometers per hour
75 miles per hour = 120.7 kilometers per hour

METRIC TO CUSTOMARY

Linear Measure

millimeters (mm)	fractions of an inch (to nearest 1/64″)
1	3/64 −
2	5/64 +
3	7/64 −
4	11/64 −
5	13/64 −
6	15/64 +
7	17/64 +
8	5/16 +
9	23/64 −
10	25/64 +

Formula:
millimeters × .039 37 = inches

centimeters (cm)	inches (to nearest 1/64″)
1	25/64 +
2	25/32 +
3	1 3/16 −
4	1 37/64 −
5	1 37/32 −
6	2 23/64 +
7	2 3/4 +
8	3 5/32 −
9	3 35/64 −
10	3 15/16 −

Formula:
centimeters × .393 7 = inches

meters	feet (to nearest 1/4 inch)
1	3′ 3 1/4 + ″
2	6′ 6 3/4 − ″
3	9′ 10 + ″
4	13′ 1 1/2 + ″
5	16′ 4 3/4 + ″
6	19′ 8 1/4 − ″
7	22′ 11 1/2 + ″
8	26′ 3 − ″
9	29′ 6 1/4 + ″
10	32′ 9 1/2 + ″

Formula:
meters × 3.280 8 = feet
1 kilometer = 3280.839 8 feet
= .621 371 miles

Fluid Measure

1 milliliter (ml)	= .034 − oz (fluid ounces)
10 ml	= .34 − oz
100 ml	= 3.4 − oz
1 liter	= 33.8 + oz
	= 2 pints, 2 − oz
	= 1 quart, 2 − oz

Formulas:
liters × 33.814 056 = ounces (fluid)
milliliters × .033 814 056 = ounces (fluid)

Weight

grams	ounces (avoirdupois)
1	.035 +
10	.353 −
50	1.76 +
100	3.52 −
500	1 lb 1.7 − oz
1000	2 lb 3.3 − oz

Formula:
grams × .035 273 99 = ounces (avoirdupois)

kilograms	pounds (to the nearest ounce)
1	2 lb 3 + oz
2	4 lb 7 − oz
3	6 lb 9 + oz
4	8 lb 13 + oz
5	11 + lb
6	13 lb 4 − oz
7	15 lb 7 − oz
8	17 lb 10 + oz
9	19 lb 13 − oz
10	22 lb 1 − oz

Formula:
kilograms × 2.204 622 4 = pounds
1 metric ton (1000 kg) = 2 204.6 pounds

Volume

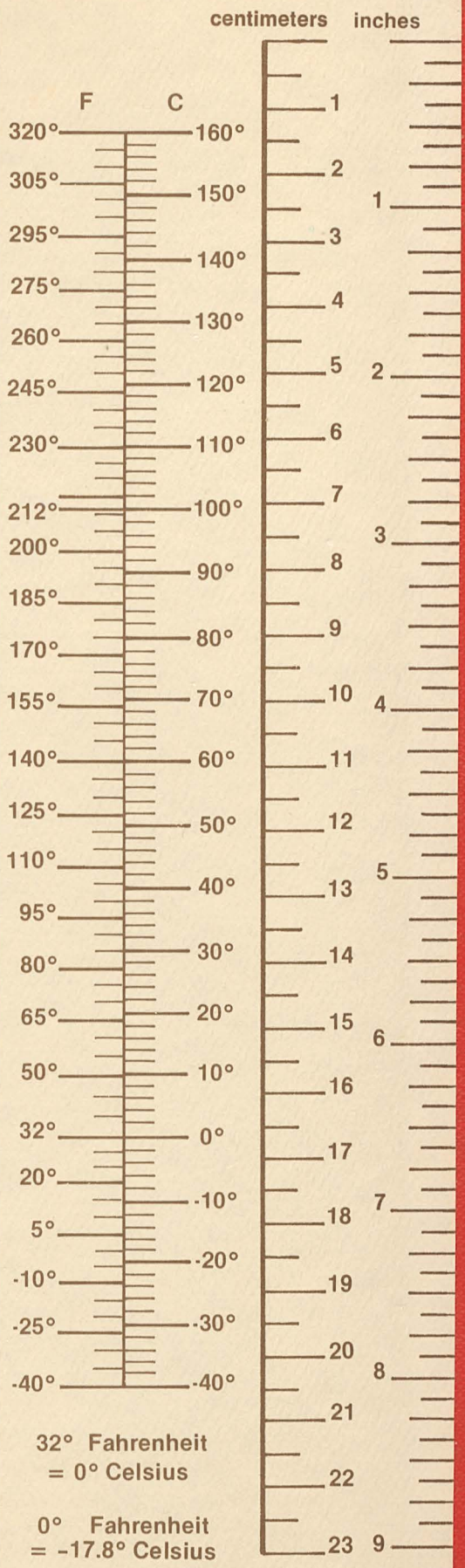
1 cubic centimeter (= 1 milliliter) = .061 + cubic inches
1 liter (1000 cc) = 61 + cubic inches
1 cubic meter = 35.3 + cubic feet

Area

1 square centimeter = .155 square inches
1 square decimeter = 15.5 square inches
1 square meter = 9.29 square feet = .84 − square yards
1 hectare (10 000 sq. meters) = 2.47 + acres

Miscellaneous

1 newton (N) = 4.45 − pounds of force
1 pascal (Pa) (pressure) = .000 145 + psi
= .021 − pounds per sq ft
1 kilopascal (kPa) = .145 + psi
= 21 − pounds per sq ft
25 kilometers per hour (km/h) = 15.5 + mph
50 km/h = 31.1 − mph
75 km/h = 46.6 + mph
100 km/h = 62.1 + mph
Formula:
km/h × .621 371 = miles per hour



32° Fahrenheit = 0° Celsius

0° Fahrenheit = -17.8° Celsius